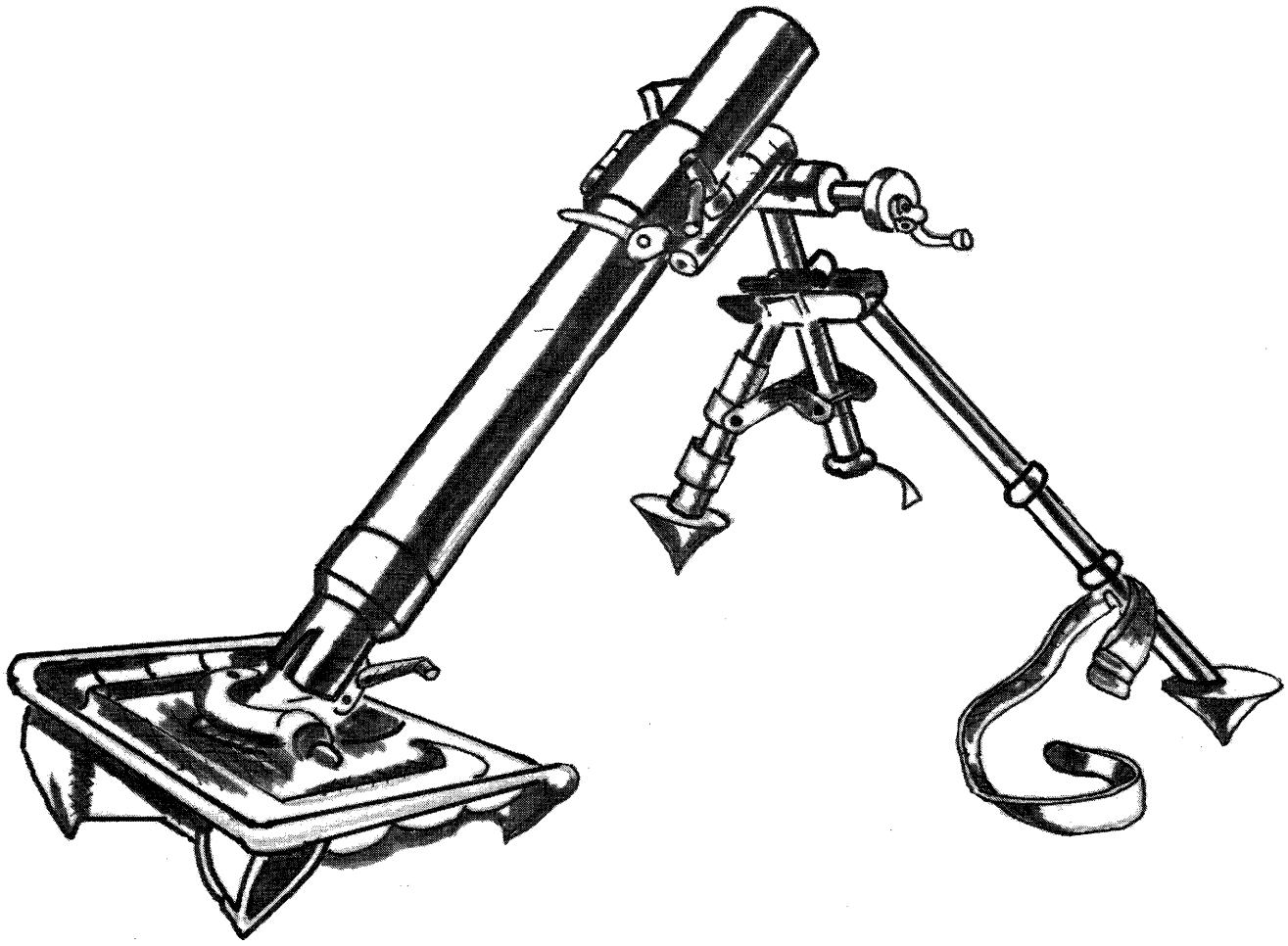
MCI 03.23 f

THE 60-MM MORTAR



MARINE CORPS INSTITUTE
MARINE BARRACKS
WASHINGTON, D.C.

UNITED STATES MARINE CORPS
MARINE CORPS INSTITUTE, MARINE BARRACKS
BOX 1775
WASHINGTON, D.C. 20013

03.23f
16 Aug 1977

1. PURPOSE

This publication has been prepared by the Marine Corps Institute for use with MCI course, The 60-mm Mortar.

2. APPLICABILITY

This manual is for instructional purposes only.

B. W. GARDNER
Lieutenant Colonel, U.S. Marine Corps
Deputy Director

PREFACE

This manual was prepared to provide a complete coverage of the mortar crewman's duties from the time a mortar is mounted until effective fire is delivered on a target. Today's ammo carrier in a mortar squad may, by the necessity of combat, be tomorrow's gunner. This manual will give a Marine a sufficiently broad base of knowledge to enable him to perform the tasks set forth for different billets within the squad. By being able to perform the tasks of multiple billets, a Marine becomes a more proficient mortarman, thereby helping to ensure the success of his unit in combat.

SOURCE MATERIALS

FM 23-85	60-mm Mortar, M19, Feb 1967
FM 23-91	Mortar Gunnery, Dec 1971
TM 9-3071-1	Mortars 60-mm M2, M19, 81-mm M1, M29, Jan 1958 w/Ch 1
TM 9-1300-203	Artillery Ammunition, Apr 1967 w/Ch 1 through Ch 19
TM-8000-10/1	Preventive Maintenance Indicators Ordnance Materiel, Jun 1971 w/Ch 1 and 2
SL-3-04706	Components List for 60-MM Mortar M2 and M19, Sep 1970
TM-4700-15/1A	Tactical Equipment Record Procedures, Jun 1967 w/Ch 1-11
Ti-4700	U. S. Marine Corps Technical Instruction, Sep 1973

CONTENTS

	Para	Page
Preface		i
Source materials		i
Table of contents		iii
Chapter 1. INTRODUCTION, ORGANIZATION, AND NOMENCLATURE		
Section I. Introduction		
History and mission	1-1	1-1
Characteristics of the mortar	1-2	1-1
Section II. Organization		
Organization of the 60-mm mortar section	1-3	1-2
Section III. Nomenclature		
Introduction	1-4	1-3
Mortar barrel assembly	1-5	1-3
Bipod	1-6	1-4
M5 Baseplate	1-7	1-6
M1 Baseplate	1-8	1-7
Firing mechanism	1-9	1-7
Spare parts and equipment	1-10	1-10
Section IV. Preventive Maintenance		
Lubricants and cleaning materials	1-11	1-12
Care and cleaning when no firing is done	1-12	1-13
Care and cleaning before firing	1-13	1-14
Care and cleaning after firing	1-14	1-14
Inspection	1-15	1-16
Weapon Record Book	1-16	1-16
Chapter 2. SIGHTING EQUIPMENT		
M4 Sight	2-1	2-1
Operation of the M4 sight	2-2	2-6
Care and preservation	2-3	2-8
M10 aiming posts	2-4	2-8
M37 instrument light	2-5	2-9
Sight extension	2-6	2-10
M14 aiming post light	2-7	2-10
Chapter 3. AMMUNITION		
Section I. Mortar rounds		
General	3-1	3-1
Types of 60-mm mortar rounds	3-2	3-3
Care, handling, and preservation	3-3	3-7

	Para	Page
Section II. Fuzes		
Fuze, point detonating, M525A1	3-4	3-7
Fuze, point detonating, M527A1	3-5	3-9
Fuze, time (fixed), M65A1 or M65	3-6	3-10
Section III. Propelling charges, firing tables, and storage of ammunition		
Propelling charges	3-7	3-11
Firing tables	3-8	3-14
Storage of ammunition	3-9	3-14
Section IV. Destruction of mortar ammunition and materials		
General	3-10	3-14
Methods of destroying the mortar	3-11	3-15
Destruction of ammunition	3-12	3-15
Destruction of fire-control equipment	3-13	3-16
Destruction of captured enemy materiel	3-14	3-16
Chapter 4. TRAINING FOR THE CREW		
Section I. Introduction, mounting, and dismounting the mortar		
Introduction	4-1	4-1
Mounting	4-2	4-1
Dismounting	4-3	4-2
Section II. Sight setting and laying		
Sight setting	4-4	4-3
Establishing initial direction	4-5	4-3
Laying for direction	4-6	4-3
Laying for elevation and direction	4-7	4-5
Laying for direction by compass	4-8	4-5
Laying the section parallel	4-9	4-6
Night laying	4-10	4-6
Checking for mask clearance and overhead interference	4-11	4-6
Section III. Manipulation		
Manipulation for traversing fire	4-12	4-7
Manipulation for searching fire	4-13	4-7
Marking base deflection	4-14	4-8
Placing of additional aiming stakes	4-15	4-8
Chapter 5. CREW DRILL AND GUNNER'S EXAMINATION		
Section I. Crew drill		
Introduction	5-1	5-1
Duties of squad members	5-2	5-1
Squad commands	5-3	5-1
Squad equipment	5-4	5-2
Placing the mortar in action	5-5	5-3

	Para	Page
Section II. Gunner's examination		
Introduction	5-6	5-4
Supervisory personnel	5-7	5-4
Examination subjects	5-8	5-4
Qualification scores	5-9	5-4
General rules governing examination	5-10	5-5
Qualification course	5-11	5-5
Step I - Mounting the mortar	5-12	5-5
Step II - Laying the mortar with initial fire data	5-13	5-7
Step III - Re-laying the mortar for changes in firing data	5-14	5-8
Step IV - Marking base deflection	5-15	5-9
Step V - Laying mortar on additional aiming stake	5-16	5-10
Step VI - Manipulation of the mortar for traversing fire	5-17	5-11
Chapter 6. TECHNIQUE OF MORTAR FIRE		
Section I. Introduction to mortar fire		
General	6-1	6-1
Communication	6-2	6-1
Definition of common terms	6-3	6-2
Announcement of numbers	6-4	6-3
Section II. Fire commands		
Introduction	6-5	6-3
Initial fire commands	6-6	6-4
Examples of initial fire commands	6-7	6-5
Subsequent fire commands	6-8	6-5
Examples of subsequent fire commands	6-9	6-6
Repeating and correcting commands	6-10	6-6
Section III. Firing the mortar		
Procedures before and during firing	6-11	6-6
Misfires	6-12	6-9
Common mistakes and malpractices	6-13	6-11
Out of action	6-14	6-12
Section IV. Emplacement of mortars		
Mortar positions	6-15	6-12
Chapter 7. FORWARD OBSERVATION, FIRE CONTROL INSTRUMENTS, AND TACTICAL EMPLOYMENT		
Section I. Forward observation		
Introduction	7-1	7-1
Mission	7-2	7-1
Determination of initial data	7-3	7-1
Direct alinement method	7-4	7-2
Direct laying method	7-5	7-2
Compass direction method	7-6	7-3
Parallel line method	7-7	7-4
Map method	7-8	7-4
Range determination	7-9	7-5
Lateral distance determination	7-10	7-6
Spotting mortar bursts	7-11	7-7
Observer within 100 meters of mortar postion	7-12	7-8
Observer more than 100 meters from mortar position	7-13	7-8

	Para	Page
Section II. Fire control instruments		
Lensatic compass	7-14	7-11
Binocular M13A1	7-15	7-12
Mil scale alidade	7-16	7-13
Section III. Tactical employment		
Types of employment	7-17	7-14
Offensive employment	7-18	7-14
Defensive employment	7-19	7-15
APPENDIX I. THE MIL RELATION	I-1	I-1
II. FIRING TABLES	II-1	II-1

Chapter 1

INTRODUCTION, ORGANIZATION, AND NOMENCLATURE

Section I. INTRODUCTION

1-1. HISTORY AND MISSION

a. The 60-mm mortar was employed by Marine rifle companies in World War II and in Korea. In the late 1950's the 60-mm mortar was taken out of Marine Corps T/E.

b. With the deployment of Marines in Vietnam and because of the nature of the combat operations in that country, the need for a lightweight, high angle-of-fire, close support weapon in the rifle company became evident. The 60-mm mortar was put back in the rifle company T/E to satisfy this requirement. In January 1972 the 60-mm mortar was again deleted from the Marine rifle company T/E. The Marine Corps still requires mortarmen to be proficient with this weapon in the event that 60-mm mortar returns to the rifle company T/E. 60-mm mortars with associated equipment are maintained in the infantry battalions for this purpose.

c. The mission of the 60-mm mortar section is to provide close supporting fires that are rapidly responsive to the needs of the company commander and the rifle platoons.

1-2. CHARACTERISTICS OF THE MORTAR

a. Introduction. The 60-mm mortar, M19, is a smooth bore, muzzle-loaded, high angle-of-fire weapon. It is capable of firing from a position on a reverse slope at a target in defilade. The mortar, hereafter referred to as the barrel, is assembled into a single unit. The mount consists of two units: the bipod and baseplate (fig 1-1).

The mortar may be used for direct fire missions by eliminating the bipod and substituting the small baseplate, M1 (fig 1-2), for the conventional baseplate. When employed with the M1 baseplate, the mortar is referred to as a hand-held mortar and may be operated by one man.

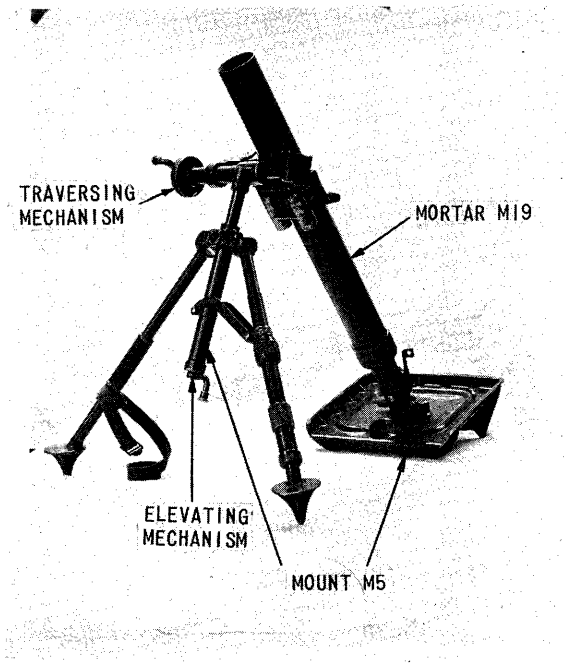


Fig 1-1. 60-mm mortar, M19, and mount, M5.

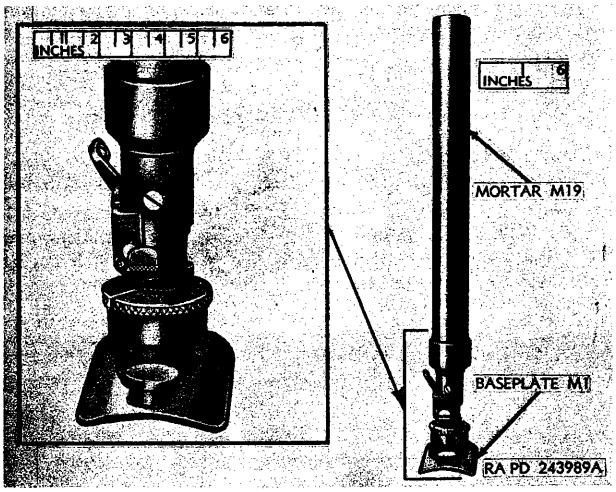


Fig 1-2. 60-mm mortar, M19, and 60-mm mortar baseplate, M1.

b. Data.

Weight of mortar and mount M5	45.2 lb
Weight of mortar	16.0 lb
Weight of baseplate M5	12.8 lb
Weight of bipod	16.4 lb
Weight of baseplate M1	4.5 lb
Length of mortar	32.25 in.
Elevation, w/mount M5	40° to 85°; 710 to 1510 mils.
Elevation, w/mount M1	up to 85°; up to 1510 mils.
One turn of elevating crank (approx)	1/2°; 10 mils.
Traverse, w/mount M5, right or left (approx)	125 mils
One turn of traversing handwheel (approx)	15 mils
Rate of fire: rapid	30 rnds/min
sustained	18 rnds/min
Range: Maximum approximate	
HE, M49A4	1800 meters
Smoke, M302A1	1450 meters
Practice, M50A2E1	1800 meters
Training, M69	225 meters
Illuminating, M83A3	1000 meters

Section II. ORGANIZATION

1-3. ORGANIZATION OF THE 60-MM MORTAR SECTION

a. The 60-mm mortar is the company commander's own light, portable artillery and is known as his weapon of opportunity. The mortar section is organic to the weapons platoon of a rifle company and consists of 13 men (fig 1-3). It is composed of a section headquarters and 3 mortar squads. The section headquarters has 1 man, a sergeant, as section leader. He is responsible for the training, employment and supervision of the personnel in his section. There are 3 mortars in a section.

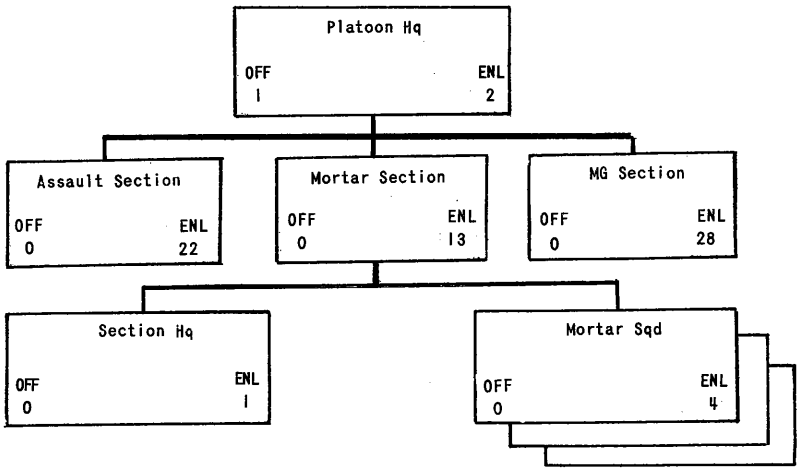


Fig 1-3. Organization of the mortar section in the weapons platoon.

b. The mortar squad has four men, each of whom is assigned specific duties in carrying the mortar and equipment, in executing movements with the mortar and equipment, in placing the mortar in action, and in servicing the mortar. A detailed discussion of the squad members will be covered later in the course.

Billet Description*	Rank	Mos	Enl	Wpn
Section Leader	Sgt	0341	1	M16
Squad Leader/Gunner	Cpl	0341	3	Pistol
Asst Gunner	LCpl	0341	3	Pistol
Ammo Man	Pvt	0341	6	M16

*Note: All billets within the 60-mm mortar section are designated as contingency billets and at present are not authorized to be manned unless directed by CMC.

Fig 1-4. Organization of the 60-mm mortar section.

Section III. NOMENCLATURE

1-4. INTRODUCTION

The 60-mm mortar consists of two main components; the mortar barrel assembly and the mount. There are two mounts (M5 and M1) that may be used with the M19 mortar. The M5 mount has two major components; the M2 bipod and the M5 baseplate. The M1 mount consists only of the M1 baseplate.

1-5. MORTAR BARREL ASSEMBLY

The mortar barrel assembly (fig 1-5) consists of the barrel and combination base cap and firing mechanism.

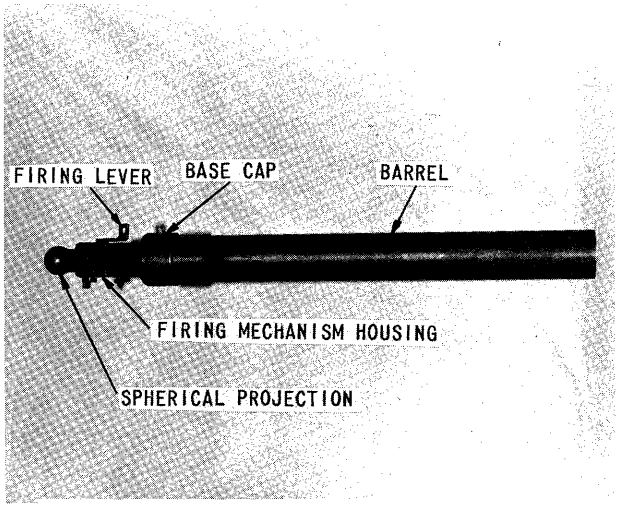


Fig 1-5. 60-mm mortar barrel assembly, M19.

a. The barrel is bored smooth and carefully finished in interior dimensions and surfaces.

b. The base cap is hollowed and threaded so that it can be screwed to the barrel, thereby closing the breech end of the barrel. The firing mechanism housing is attached to the base cap by a threaded adapter. The spherical projection, which fits into and locks the socket of the baseplate, is a prolongation of the firing mechanism housing.

c. The firing mechanism consists mainly of a firing pin, firing pin striker, firing spring, striker pawl, trigger, and firing lever. A firing selector, which acts as a cam on the rear end of the firing pin striker, permits the mortar to be fired with the firing lever.

1-6. BIPOD

The bipod (fig 1-6) consists of the leg assembly, elevating mechanism assembly, and traversing mechanism assembly.

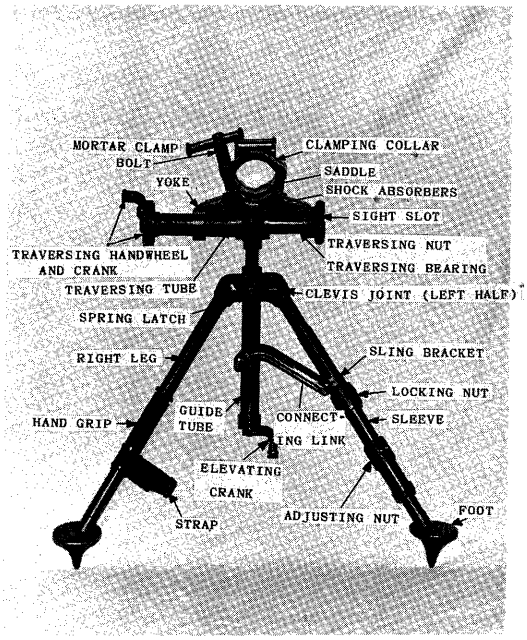


Fig 1-6. Bipod, M2.

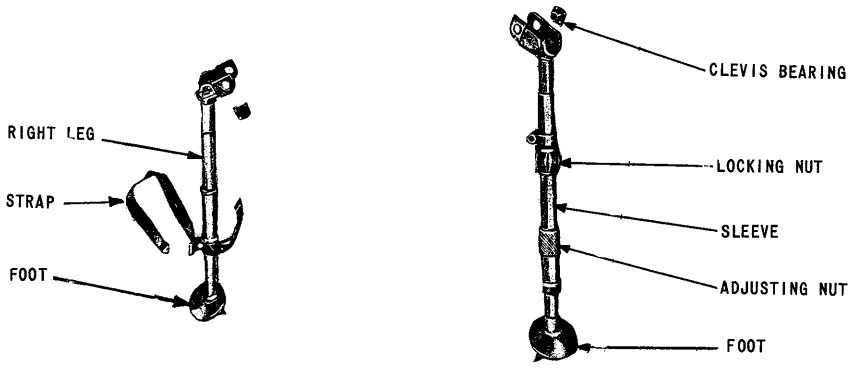


Fig 1-7. Leg assembly.

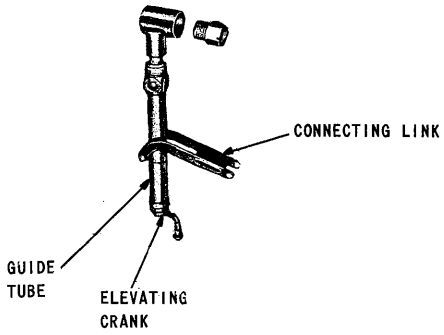


Fig 1-8. Elevating mechanism assembly.

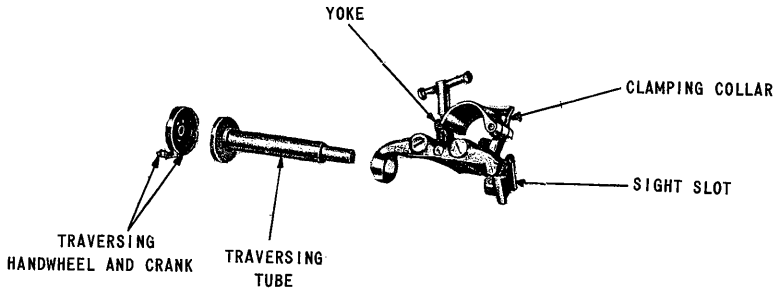


Fig 1-9. Traversing mechanism assembly.

a. Leg assembly (fig 1-7). The leg assembly consists of two tubular steel legs connected by a clevis joint that is attached by two bearings (front and rear) to the elevating screw guide tube. The clevis joint limits the spread of the legs. Each half of the clevis joint is provided with a spring latch to lock the legs in the open position. The legs terminate in spiked feet.

(1) The left leg has a cross-leveling mechanism that provides the gunner with a means of keeping the bubble in the cross level of the sight centered. It is necessary to keep the sight cross-leveled, because when that condition exists the white line in the collimator of the sight is vertical. When the line in the collimator is vertical and laid on the aiming stake, the angle between the line of fire and the line of sight is the correct angle as indicated on the deflection scale of the sight. In other words, when the mortar is cross-leveled the barrel points in the desired direction. The cross-leveling mechanism consists of a sliding bracket, a sleeve, a locking nut, an adjusting nut, and a connecting link. The sliding bracket is mounted on the sleeve and locked in the desired position on the sleeve by the locking nut. The sliding bracket is also connected to the guide tube by the connecting link. The adjusting nut moves the sleeve up or down the left leg and transmits movement through the sliding bracket, connecting link, and guide tube to the yoke on which the sight is mounted. Thus, the bubble in the cross level of the sight may be centered by moving the adjusting nut.

(2) The right leg contains no moving parts. On the lower part of the right leg is a leather hand grip and a strap to secure the legs to the barrel when the mortar is carried.

b. Elevating mechanism assembly (fig 1-8). The elevating mechanism assembly consists of an elevating screw nut that moves vertically on a screw within the guide tube. The elevating screw is turned by the crank attached to its lower end. The upper end of the elevating screw nut fits into the lower end of the traversing bearing and is locked to it by a pin. The elevating screw remains within the guide tube when the elevating crank is turned. The elevating screw nut appears above the guide tube when the mortar is elevated.

c. Traversing mechanism assembly (fig 1-9). The traversing mechanism assembly consists of the traversing mechanism, shock absorbers, and clamp.

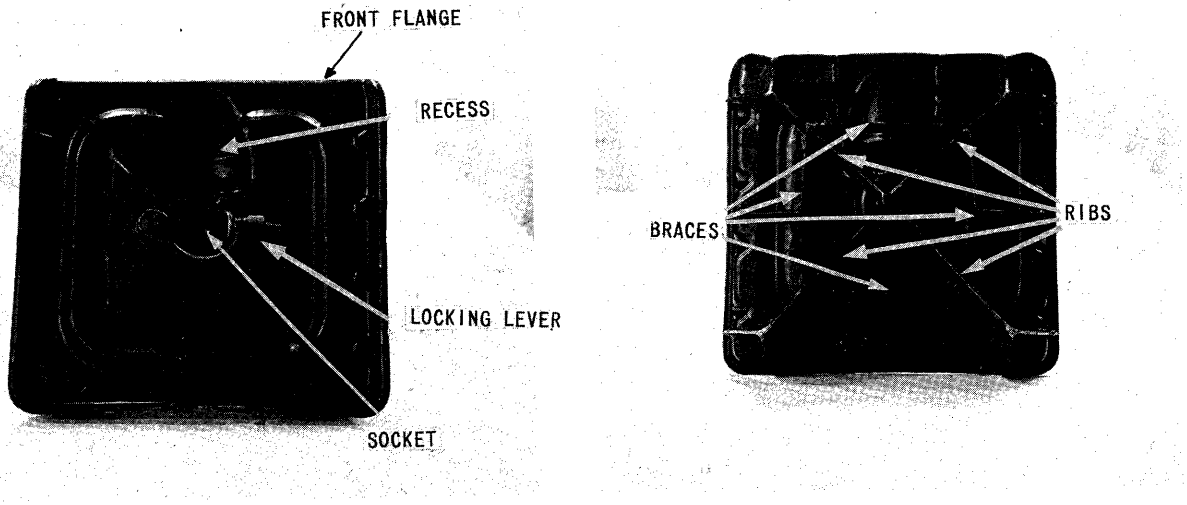
(1) The traversing mechanism is a telescoping type of mechanism and consists of a tube and nut. Turning the handwheel causes the nut to move back and forth within the tube, thus moving the yoke and traversing the mortar. The yoke provides the bearing for the traversing mechanism and connects the mortar clamp and the elevating mechanism. The sight bracket fits into a dovetail slot in the yoke.

(2) The shock absorbers stabilize the mortar and mount during firing. They permit movement between the yoke and the clamp assembly and are countered by the resistance of two coil compression springs, which are mounted in the shock absorber retainers of the saddle.

(3) The clamp is in two sections and clamps the barrel to the bipod. The lower half is called the saddle and includes two shock absorber retainers with locking screws. The upper half of the clamp is called the clamping collar. The two halves of the clamp are hinged and can be locked tightly together by the clamp bolt. When secured about the barrel, they lock it firmly to the bipod. The clamping collar is placed around the barrel so that 10 inches of the barrel extend in front of the collar.

1-7. M5 BASEPLATE

The M5 baseplate (fig 1-10) is a pressed steel body to which are welded a series of ribs and braces, a front flange, and the socket. A locking lever is mounted on a pivot on the left of the socket to lock the spherical projection of the mortar in the socket. The base cap fits into the recess in the forward part of the baseplate when the entire mortar is carried as one unit.



A. Top.

B. Bottom.

Fig 1-10. M5 baseplate.

1-8. M1 BASEPLATE

The M1 baseplate (fig 1-11) is a curved metal base with a ball socket shaped to receive the spherical projection. Part of the ball socket consists of a split nut that fits around the spherical projection and then screws into the socket on the baseplate to hold the spherical projection secure. A carrying strap may be fastened at one end to the stud on the baseplate. The other end of the strap is permanently attached to the muzzle cover.

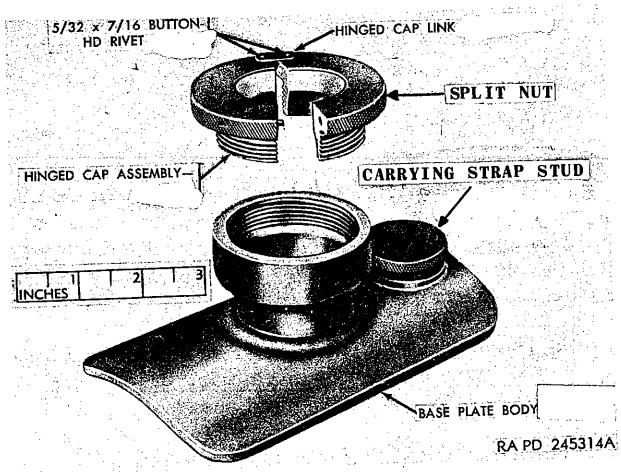


Fig 1-11. M1 baseplate.

1-9. FIRING MECHANISM

a. Description. The moving parts of the firing mechanism are within or attached to the combination base cap and firing mechanism assembly. The firing pin is assembled in the firing mechanism adapter. It is held in a retracted position by the retracting spring at all times, except when the striker exerts pressure on the rear end of the firing pin. This pressure causes it to protrude 1/20 inch beyond the surface of the firing pin bushing. As pressure is applied to the level arm, the tripper forces the striker to the rear against the action of the firing spring until the cam surface becomes disengaged from the striker groove. The striker is released and

shoots forward to strike the firing pin and thus fires the piece. When the firing selector is set at DROP FIRE the cam surface of the selector acts directly on the rear of the striker, forcing it forward, and holding it against the rear end of the firing pin. This causes the firing pin to remain extended 1/20 inch beyond the surface of the firing pin bushing.

b. Functioning (fig 1-12). The mortar is fired by inserting a complete round in the muzzle. The elevation of the barrel allows the round to slide toward the base of the barrel. When the firing selector is set on drop fire, the primer of the ignition cartridge strikes the firing pin located inside the base cap. The flame from the exploding cartridge ignites the propelling charge. The gas pressure produced from the burning propellent drives the round up and out of the barrel, arming the fuze. When fired, the round carries the fired ignition cartridge case with it. The mortar is then ready for the next round. When the firing selector is set on lever fire, the lever is tripped to ignite the ignition cartridge after the round has come to rest against the base cap.

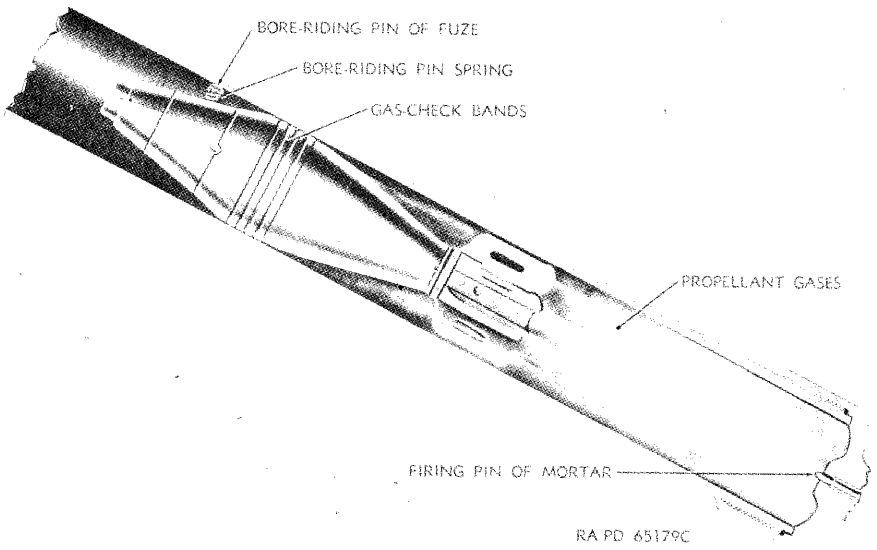


Fig 1-12. Functioning of the 60-mm mortar.

c. Replacing a broken firing pin. Remove the firing mechanism adapter from the base cap, and unscrew the firing pin bushing from the adapter. Remove the broken firing pin, place the retracting spring, stop washer, and spring lock on a new firing pin, and assemble.

d. Disassembling the firing mechanism. The mortar crew may disassemble the firing mechanism (fig 1-13); however, this is the only part of the mortar disassembled by other than ordnance personnel. Follow this procedure in disassembling and assembling the firing mechanism:

(1) Remove the lock screw from the firing mechanism housing.

(2) Unscrew in a counterclockwise direction the complete firing mechanism housing assembly from the base cap.

(3) Remove the firing pin striker, firing spring, and firing spring stop.

(4) Remove the housing cover pin by drifting it out to the left.

(5) Push in on the selector plunger and remove the housing cover, firing selector, selector plunger and spring, firing lever, tripper, and firing lever spring and sleeve.

(6) Taking up the barrel and base cap, remove the housing adapter by screwing it in a clockwise direction and allowing it to slide out the muzzle end of the barrel. (DO NOT UNSCREW THE BASE CAP FROM THE TUBE.)

(7) Remove the firing pin assembly from the housing adapter by turning the firing pin bushing in a counterclockwise direction.

(8) Remove the stop washer and retracting spring from the firing pin by pressing the firing pin lock against the action of the retracting spring until the lock slides out through the lock recess.

e. Assembling the firing mechanism. Follow this procedure for assembling the firing mechanism:

(1) Place the stop washer and retracting spring on the rear shank of the firing pin and lock in place with the firing pin lock.

(2) Place the firing pin assembly in the mushroom end of the housing adapter and secure the assembly by replacing the firing pin bushing. Set the bushing securely with the wrench provided for that purpose.

(3) Replace the housing adapter in the base cap by sliding it down the barrel until the slotted collar protrudes from the base cap. Then screw it firmly into place in a counterclockwise direction.

(4) Pick up the firing mechanism housing in the left hand with the raised square surface up and the spherical projection to the rear; replace the firing lever spring and sleeve in the upper forward hole in the right side of the housing.

(5) Hold the tripper in the right hand with the point to the front and the flat cam surface up; position it in the rectangular hole in the flat surface of the housing by starting the pointed cam in first. Keep it pointed toward the front of the firing mechanism housing. While holding the tripper in place from the inside with the index finger of the left hand, replace the firing lever in the hole on the left with the lever arm up and to the front. Set the firing lever spring sleeve flush with the surface of the housing.

(6) Replace the selector plunger and spring in the rear upper hole, and the firing selector in the lower hole on the right side of the housing.

(7) Replace the housing cover and pin. The pin is drifted in from left to right. Press the selector plunger in flush with the housing surface while replacing the housing cover.

(8) Place the firing spring and spring stop on the striker. The spring stop sleeve must protrude beyond the face of the striker.

(9) Place the striker in the housing with the groove in line with the tripper. Set the firing selector at LEVER FIRE and screw the complete firing mechanism housing assembly securely to the housing adapter in a clockwise direction.

(10) Test the firing mechanism by tripping the firing lever. If it functions properly, replace the screw lock in the right side of the housing.

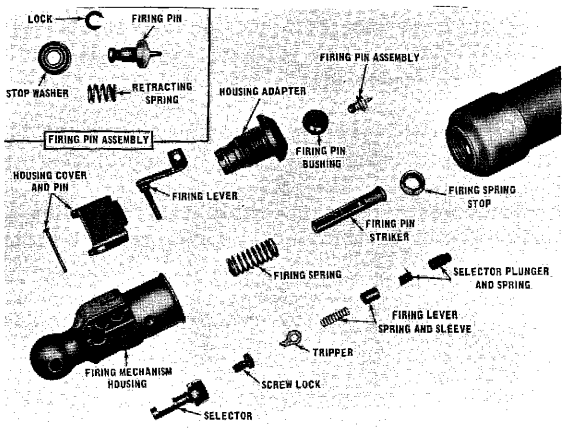


Fig 1-13. Firing mechanism assembly --exploded view.

1-10. SPARE PARTS AND EQUIPMENT

a. Introduction. In order for a mortar crewman to become proficient with his weapon, he must have a thorough knowledge of the spare parts and equipment used with it. A brief discussion of these items is included in this paragraph. A more detailed list of these items may be found in Ord 9SNLA-43.

b. Spare parts. The parts of any mortar become unserviceable in time through breakage or wear resulting from continuous usage. For this reason, spare parts are provided for replacement purposes. Keep sets of spare parts complete at all times. Whenever a spare part is used to replace a defective part, repair the defective part or substitute a new part in the set. Carry complete parts at all times, assembled and ready for immediate use. The only spare part the squad carries is an extra firing pin. The company armorer keeps the remaining spare parts.

c. Accessories. Accessories include the tools used for maintenance of the mortar, tool rolls, chests, and other equipment necessary for storage and protection when the mortar is not in use or when traveling. Use the accessories for prescribed purposes only. When not in use, store them in the places or receptacles provided.

(1) The M1 ammunition bag (fig 1-14) consists of a single pouch and a shoulder carrying strap. It can be used to carry ammunition or the tool roll, firing tables, and flashlight.

(2) The M2A1 ammunition bag is a reinforced strip of canvas with pockets in the front and rear for the ammunition.

(3) The M308A1 muzzle cover (fig 1-15), with carrying strap, is used to protect the mortar bore from foreign matter and moisture. The attached strap is used as a sling when carrying the mortar.

(4) The M3 shoulder pad (fig 1-16), consists of two pads, one for the left and one for the right shoulder. They are strapped together and provide protection for the shoulders of the squad members.

(5) Sighting equipment used with the 60-mm mortar includes the M10 aiming post, M14 aiming post light, M37 instrument light, and M4 sight extension. These items will be discussed in chapter 2.

(6) Cleaning materials used with the 60-mm mortar include the M9 cleaning staff, M6 chamber cleaning brush, and the oiler. These items will be discussed later in this chapter.

Fig 1-14. M1 ammunition bag.

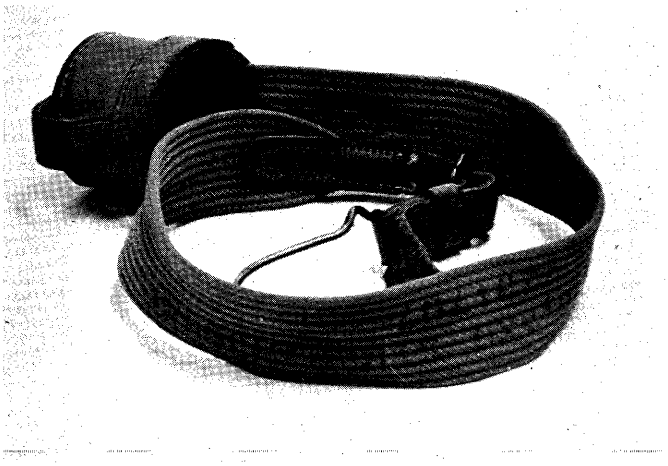


Fig 1-15. 308A1 muzzle cover.

Fig 1-16. M3 shoulder pad.

Section IV. PREVENTIVE MAINTENANCE

1-11. LUBRICANTS AND CLEANING MATERIALS

a. Introduction. The crew performs the care and cleaning of the mortar and its accessories. Experience has shown that this weapon becomes unserviceable through lack of care rather than from use. Dirt and grit accumulate in traveling or from the blast of the mortar in firing from cutting compounds. Powder foulings settle between and on operating parts and attract moisture, prevent proper operation of moving parts, and hasten the formation of rust. Clean dirt, grit, and powder foulings from all parts at frequent intervals, depending upon use and service. If rust should accumulate, remove it from bearing surfaces carefully so that the clearances are not unduly increased. Use a crocus cloth. The use of coarse abrasives is strictly forbidden. When the mortar is not in use, oil it properly and place it under cover.

b. Authorized cleaners and lubricants. The materials authorized and issued for cleaning and lubricating the mortar are:

Rifle-bore cleaner.
Soap solution.
Special preservative, lubricating oil.
Lubricating oil for aircraft instruments and machineguns.
Light rust-preventive compound.
Drycleaning solvent.

(1) Rifle-bore cleaner is issued for cleaning the bore of the mortar after firing. This material possesses rust-preventive properties and provides temporary protection against rust. For better protection, however, dry the bore immediately after cleaning with rifle-bore cleaner and coat the metal lightly with special preservative lubricating oil. Rifle-bore cleaner freezes at temperatures below 32° F. When frozen, thaw it out and shake it up well before using. During freezing weather, fill closed containers not more than three-fourths full, because full containers burst when the contents freeze.

(2) Use a soap solution for cleaning the bore when rifle-bore cleaner is not available. To prepare this solution, chip up one-quarter pound of issue soap and dissolve it in one gallon of hot water. This solution is better when used hot, but it can be used cold.

(3) Special preservative lubricating oil has rust-preventive as well as lubricating properties, but it cannot be depended upon to provide protection from rust for long periods. Use it to lubricate (in normal temperatures) all moving parts and for short-term protection of the bore against rust. Preservative action results partly from the oily film on the metal parts and partly from chemical combination of inhibitors in the oil with the metal. It protects the metal surfaces from rust though no appreciable film of oil is present on the metal parts. When used on moving parts it is necessary to maintain a thin film of oil to provide the necessary lubrication.

(4) Lubricating oil for aircraft instruments and machineguns is the proper lubricant to be used in temperatures below 0° F. It is an extremely light oil that relies entirely upon maintenance of the oil film to protect metal surfaces from rusting. When it is used as a preservative, inspect the metal parts daily for rust. When rust is found, clean and coat them again lightly with the oil.

(5) Light rust-preventive compound is issued for the protection of metal parts for long periods of time while the parts are boxed and in storage. It can be applied with a brush at temperatures above 60° F. However, the best method is to apply it hot, either by brushing or dipping.

(6) Drycleaning solvent is a noncorrosive petroleum solvent that removes grease, oil, or rust-preventive compound. It is highly flammable. Do not use it near open flames. Smoking is prohibited where drycleaning solvent is used. Apply it with rag swabs to large parts and use it as a bath for small parts. Dry the surfaces thoroughly with clean rags immediately after using the solvent. Wear gloves when handling the parts after cleaning to avoid leaving finger marks, which are ordinarily acid and induce corrosion. Drycleaning solvent attacks and discolors rubber.

c. Authorized cleaning instruments. The instruments authorized and issued for cleaning and lubricating the mortar are:

Chamber cleaning brush, M6.
Cleaning staff, M9.
Hand trigger-operated oiler.

(1) The M6 chamber cleaning brush (fig 1-17) consists of a steel wire core with bristles. This core is twisted in a spiral to hold the bristles in place. Use it to clean small holes and threads found in the firing mechanism assembly.

(2) The M9 cleaning staff (fig 1-17) is a rod with a handle at one end and a slotted tip at the other end. The slotted tip provides a means for securing cotton waste or rags to the staff for cleaning and oiling the bore of the mortar.

(3) The hand trigger-operated oiler (fig 1-17), is used to lubricate and apply oil to flat surfaces that require oil but have no fittings. By adding the special adapter to the oiler, it can be used to apply oil to the flush-type fittings located on the bipod.

M6 chamber cleaning brush.

Oiler.

M9 cleaning staff.

Fig 1-17. Cleaning and lubricating instruments.

1-12. CARE AND CLEANING WHEN NO FIRING IS DONE

This includes the care to preserve the condition of the mortar during the time when no firing is being done. Mortars and accessories in the hands of troops are inspected daily to check their condition and cleanliness.

a. To clean the bore, attach cotton waste to the cleaning staff and insert the waste into the bore at the muzzle end. Move the staff forward and backward several times and replace the waste. Then push the staff forward until the waste touches the bottom of the bore, and twist the staff several times to the right. This cleaning removes accumulations of dust, dirt, and thickened oil in the bore. Repeat until the waste comes out clean. After the bore has been thoroughly cleaned, saturate clean waste with special preservative lubricating oil and push it through the bore.

b. To clean the firing mechanism, disassemble, and clean all parts thoroughly with cotton waste. When cleaning the firing mechanism housing, make sure that all the holes and slots are cleaned. Use the M6 brush or a small stick wrapped with waste to clean the screw threads, holes,

and crevices. After cleaning parts, saturate clean waste with special preservative oil and apply a thin coat of oil to every part of the firing mechanism. Inspect the threads on the firing mechanism adapter and the firing pin bushing to make sure that no lint is present. Then assemble the firing mechanism to the barrel.

c. Keep all parts of the bipod and baseplate clean and free from foreign matter. Keep all moving parts and polished surfaces coated with oil. To clean the screw threads and crevices, use a small brush or small stick. To clean the metal surfaces, rub them with a dry cloth to remove moisture, perspiration, and dirt. Then wipe them with a cloth wet with a small quantity of special preservative lubricating oil. Maintain this protective film at all times. For oiling the bipod, use the oiler with adapter to apply special preservative lubricating oil to the five flush-type fittings: left leg clevis, traversing bearing, sight slot on the yoke, and left and right shock absorbers.

1-13. CARE AND CLEANING BEFORE FIRING

Before firing:

a. Dismount the main groups.

b. Clean the bore and firing mechanism with clean, dry waste. Do not apply any oil to the bore before firing.

c. Clean and oil lightly all moving metal parts with special preservative lubricating oil. Do not use grease.

d. Mount the mortar for firing.

1-14. CARE AND CLEANING AFTER FIRING

Clean the mortar bore thoroughly by the evening of the day on which it is fired, because firing causes powder and primer fouling to collect in the bore and on the firing pin. This fouling absorbs and retains moisture from the air, thereby causing rust. Remove these deposits by cleaning with rifle-bore cleaner, soap solution, or water.

a. Cleaning procedure after firing.

(1) Clean the bore, firing mechanism and all working parts on the mount. If this cannot be done at once, apply oil carefully to prevent rust.

(2) At the first opportunity, clean, oil, and inspect all parts and make needed repairs and replacements.

(3) On assembly, check the operation of the firing mechanism and bipod to make sure that functioning is correct.

b. Cleaning the bore with rifle-bore cleaner.

(1) Remove the firing mechanism and adapter.

(2) Attach clean cotton waste to the cleaning staff, saturate the waste with rifle-bore cleaner, and push it back and forth through the barrel with the cleaning staff.

(3) Repeat the operation with clean waste two or three times. Be sure the waste goes all the way through the bore before the direction is changed.

(4) Continue to swab the bore with quantities of clean, dry waste until the waste comes out clean and dry.

(5) Examine the bore carefully for cleanliness. If it is not free of all residue, repeat the cleaning process.

(6) Secure a small piece of waste, saturated with rifle-bore cleaner, and thoroughly clean the threaded adapter recess in the base cap.

(7) When the bore and adapter recess are both thoroughly clean and dry, apply special preservative lubricating oil to them with waste.

c. Cleaning the bore with soap solution.

(1) If rifle-bore cleaner is not available, use soap solution or plain water.

(2) Clean the bore and adapter recess, using a liberal quantity of soap solution in place of the rifle-bore cleaner.

(3) Rinse the barrel with clean water to remove the washing material.

(4) Dry the barrel by using clean waste. Swab the bore thoroughly until it is dry and clean.

(5) When the bore and adapter recess are clean and dry, saturate waste with special preservative lubricating oil and push it through the bore. Oil the adapter recess, but make sure that no lint is left on the threads.

d. Cleaning the firing mechanism.

(1) Disassemble the entire firing mechanism.

(2) Clean the firing mechanism adapter and firing pin with rifle-bore cleaner, or whichever cleaning agent is available to remove the primer and powder fouling.

(3) Clean all other parts of the firing mechanism with drycleaning solvent, using the waste to remove dirt from the recesses.

(4) After all parts have been cleaned and dried, saturate clean waste with special preservative lubricating oil and apply a thin coat of oil to every part of the firing mechanism.

(5) Assemble the firing mechanism, being sure that no lint remains on the thread of the firing mechanism adapter or on the firing pin bushing.

Note. The heat from firing dries the oil on the working parts of the firing mechanism and may cause the mechanism to become sluggish or fail to function during firing. When this happens, take the mechanism apart, and clean and oil it.

e. Cleaning the mount.

(1) Wipe the bipod clean, taking care to remove dirt from all crevices. Clean all moving parts with drycleaning solvent. Use the cleaning brush or a small stick covered with waste to remove dirt from all recesses.

(2) Dry all parts.

(3) Wipe all moving parts and polished surfaces with a cloth wet with special preservative lubricating oil.

(4) Apply special preservative lubricating oil to the five lubrication fittings.

(5) Operate the handwheel and cranks to distribute the oil over the working surfaces.

f. Cleaning exterior surfaces. To clean the exterior surfaces, wipe off the mortar with a dry cloth to remove dampness, dirt, and perspiration.

g. Caring for accessories. Inspect, clean, and oil the accessories.

h. Cleaning the mortar. Clean the mortar completely as soon as possible after firing. When the mortar is not to be fired on the following days, repeat the cleaning procedure as outlined for 3 days.

1-15. INSPECTION

When inspecting the mortar, observe the following points:

a. Barrel. Check general appearance and cleanliness of the bore.

b. Firing mechanism. Examine for fouling, rust, or foreign substance on any of the parts. Trip the firing lever so that the striker moves forward and strikes the base of the firing pin when the selector is on LEVER FIRE. The firing pin should protrude 1/20 inch beyond the surface of the firing pin bushing when the firing selector is on DROP FIRE.

c. Bipod. Check general appearance and see that all moving parts are lubricated.

(1) Elevating mechanism. Elevate and depress the mortar to see that the mechanism operates without binding, excess play, or undue looseness.

(2) Traversing mechanism. Traverse the mortar to see that the mechanism operates smoothly without binding or undue looseness.

(3) Cross-leveling mechanism. Operate the mechanism to see that it functions correctly without excess play. Check the index marks (for centering the bubble) to see that they are distinct.

d. Baseplate. Check general appearance. Examine the locking lever to make sure that it operates easily and locks the spherical projection securely to the baseplate.

e. Sight and its mounting. Check to see if the operating condition of the sight or rigidity of its mounting has been impaired.

1-16. WEAPON RECORD BOOK

a. General. The Weapon Record Book, Parts I and II (fig 1-18), provides an accurate historical record of the entire service life of the mortar. It provides the unit commander with exact information as to the condition and serviceability of that weapon and serves as an invaluable source of technical data to all echelons of maintenance. The value of the record book is directly dependent upon the accuracy and completeness of all entries.

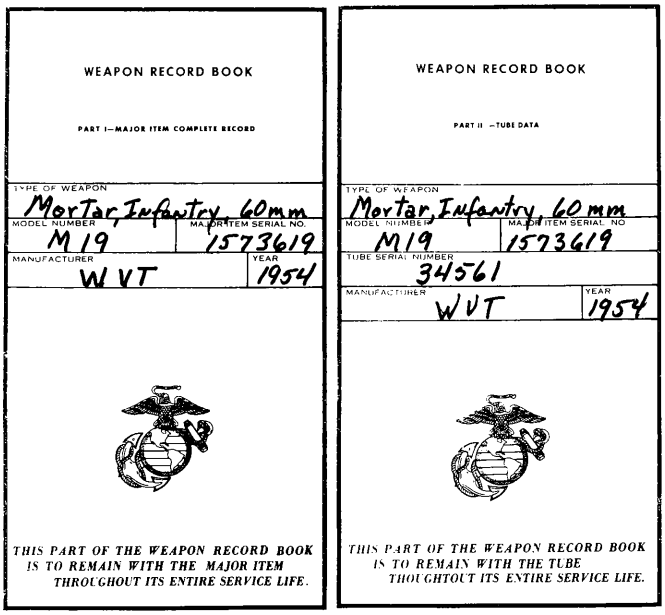


Fig 1-18. Weapon Record Book, Parts I and II.

b. Requirement. The Weapon Record Book, Part I (Form NAVMC 10558 (Rev. 5-75)) and Part II (Form NAVMC 10558A (Rev. 5-75)) is required to be maintained with the 60-mm mortar (M2 and M19). In the event the crew receives a weapon without a Weapon Record Book or loses a Weapon Record Book, the unit armorer should be contacted.

c. Entry data. It is the responsibility of the unit commander to insure that weapons requiring record books have them and timely accurate entries are made in them when the weapon is under his control. These entries are made by the crew or maintanance personnel, depending on the type of data entered.

d. General preparation instructions. The Weapon Record Book consists of two parts. Data pertinent to the major item (bipod) will be recorded in Part I. Data pertaining to the barrel will be recorded in Part II. To prevent confusion regarding the proper place to record data, note the following: Part I remains with the major item (bipod) during its entire service life; Part II remains with the barrel until it is condemned. When a barrel is installed on a bipod, Part I must be combined with Part II to form a complete book. Whenever a tube is changed, appropriate entries must be made in both Parts I and II so that the historical record remains intact.

e. Preparation instructions for Part I. Part I contains a complete history of maintenance and the results of technical inspections; therefore entries in this part of the Weapon Record Book are normally completed by maintenance personnel. Part I is covered below to provide you with general knowledge; if you should have a need for more detail refer to TM-4700-15/1 and TI-4700 dated 4 Sep 1975.

(1) Cover page - Part I (fig 1-18).

(a) Type of Weapon. Here the following entry should be made: Mortar, Infantry, 60mm.

(b) Model Number. Either M2 or M19 as applicable.

(c) Major Item Serial Number. In the case of the 60-mm mortar, the serial number located on the yoke should be entered.

(d) Manufacturer and Year. In these blocks, the name of the manufacturer (in abbreviated form) and the year manufactured is entered. If these items are not known and cannot determined, "UNK" should be entered.

(2) Summary Sheet, Weapon Component Performance (fig 1-19). In the case of the 60-mm mortar, this page contains entries on the bipod, barrel, baseplate and sight unit. These entries provide a means of determining how many rounds were fired while each component were married to the bipod.

SUMMARY SHEET
WEAPON COMPONENT PERFORMANCE

COMPONENT	SERIAL NUMBER	MODEL NUMBER	MANUFACTURER	YEAR MFR'D	INSTALLED		REMOVED	
					Date	Rounds	Date	Rounds
Bipod	1573 619	M5	WVT	1954	150ct 75	Record opened		
Barrel	34561	M19	WVT	1954	150ct 75	Record opened		
Base plate	UNK	M5	UNK	UNK	150ct 75	Record opened		
Sight unit	UNK	M4	UNK	UNK	150ct 75	Record opened		

Fig 1-19. Example of Summary Sheet Weapon Component Performance

(3) Record of Assignment (fig 1-20). This page contains information on what company and battalion the mortar was assigned and the date.

(4) Weapon Data (fig 1-21). The weapon data page provides a complete history of all maintenance and the results of all technical inspections performed. This page is to be used by maintenance personnel only.

RECORD OF ASSIGNMENTS

DATE	CO./BATY.	UNIT
1Nov 75	H:S co	2nd Bn 4th Mar
28Dec75	H:S CO	1st Bn 4th Mar

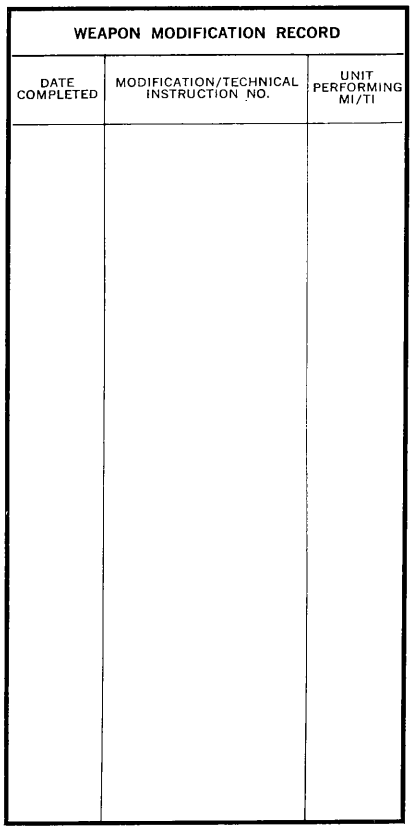
Fig 1-20. Example of Record of Assignment page.

WEAPON DATA

DATE	ENTER BELOW, RESULTS OF INSPECTIONS AND COMPLETION OF REQUIRED MAINTENANCE.
15Oct75	Conducted boresight + pullover gage + Replaced Traversing screw, FSN 5305-502-5216. Serviceable CC"B". P.W. Morris Sgt 3rd Service Bn Maint Co.
10Dec75	boresighted and pullover gage found serviceable CC"B". P.W. Morris Sgt USMC 3rd Service Bn maint Co.

Fig 1-21. Example of Weapon Data page.

(5) Weapon Modification Record (fig 1-22). The weapon modification record contains information on any modifications, the unit that completes the modification and the date completed.



WEAPON MODIFICATION RECORD		
DATE COMPLETED	MODIFICATION/TECHNICAL INSTRUCTION NO.	UNIT PERFORMING MI/TI

Fig 1-22. Example of Weapon Modification Record page.

f. Preparation instructions for Part II.

(1) Cover page - Part II (fig 1-18).

(a) Type of Weapon, Model Number and Major Item Serial Number. This information should be the same as that entered on the cover of Part I.

(b) Tube Serial Number, Manufacturer and Year. This information pertains to the barrel only and is located on the base cap.

(2) Identification of Components (fig 1-23). This information is the same as that located on the cover page of Part II except that the Total Rounds Fired and Data Unserviceable spaces are completed when the barrel is condemned and Part II of the book is being closed out. The lower section (Component, Serial Number, Manufacturer and Year) does not apply to the 60-mm mortar.

IDENTIFICATION OF COMPONENTS

TYPE OF WEAPON: Mortar, Infantry, 60 mm

TUBE SERIAL NUMBER: 34561

MANUFACTURER: WVT | YEAR: 1954

TOTAL ROUNDS FIRED: | DATE UNSERVICEABLE:

COMPONENT	SERIAL NUMBER	MANUFACTURER	YEAR
CANNON OR BREECH RING			
CARRIAGE OR MOUNT			
RECOIL MECH.			

REMARKS

Fig 1-23. Example of Identification of Components page.

(3) Unit Commander's Record (fig 1-24). Entries in the unit commander's page of the weapon record are recorded by the crew. The unit commander's page is perhaps the most important page in either Part I or II of the Weapon Record Book. A failure to record the required data may lead to an unsafe weapon condition. It is the unit commander's direct responsibility to ensure that all required data is recorded expeditiously and precisely and that all cumulative data is correct.

(a) Date. Enter the date that firing was conducted.

(b) Type of Round. Enter the type (TP M50A2, HE M49A4, WP M302A2, etc.) of round fired on that day. If more than one type of ammunition was fired on a given day, enter each type on successive separate lines, using the same date.

(c) Zone. Does not apply to the 60-mm mortar, therefore, enter N/A.

(d) No. of RNDS./EFC Value. The EFC Value does not apply to the 60-mm mortar; therefore, in this space enter the number of rounds fired.

(e) Page Total. Enter the total number of rounds recorded on that page

(f) Total From Previous Page. Record in this space the accumulative total from the previous page.

(g) Accumulative Total. Contains the number of rounds fired and recorded on this page and the previous page.

(4) Pullover Gage Inspection Record (fig 1-25). This page contains the results of pullover gage inspections conducted by maintenance personnel.

UNIT COMMANDER'S RECORD

DATE	TYPE OF ROUND	ZONE	NO. OF RNDS. ~~EFC~~ VALUE
2 NOV 75	TPM50A2	NA	15
2 NOV 75	HEM49A4	-	21
14 NOV 75	WPM302A2	-	38
18 NOV 75	TPM50A2	-	53
18 NOV 75	HEM49A4	-	12
18 NOV 75	ILLUM M83A1	-	9
18 NOV 75	WPM302A2	-	16
27 NOV 75	TPM50A2	-	28
27 NOV 75	ILLUM M83A1	-	19
27 NOV 75	HEM49A4	-	12
5 DEC 75	HEM49A4	-	16
	PAGE TOTAL		239
	TOTAL FROM PREVIOUS PAGE		0
	ACCUMULATIVE TOTAL		239

Fig 1-24. Example of Unit Commander's Record.

PULLOVER GAGE INSPECTION RECORD

DATE	TOTAL ROUNDS OR EFC'S TO DATE	PULLOVER GAGE OF LANDS AT ..... FROM BREECH END OF TUBE.
15 OCT 1975	New Record opened	2.395"
10 Dec 1975	239	2.395"

Fig 1-25. Example of Pullover Gage Inspection Record.

(5) Bore Inspection Record. This page provides maintenance personnel with a place to record the results of all bore inspections, whether gage type or bore-scope type inspections.

BORE INSPECTION RECORD		
DATE	Estimated Remaining Tube life as per TM 9-1000-202-35	Remarks on condition of bore and chamber, results of ballistic calibration firings, damage to tube, serviceability, etc. *(Reasons for condemnation)*
15 Oct 75		Serviceable Bore scoped and gaged cc "B" P.La Monica Sgt 3rd Service Bn maint co
10 Dec 75		Serviceable Bore scoped and gaged cc "B" P.La Monica Sgt 3rd Service Bn maint. co.

Fig 1-26. Example of Bore Inspection Record.

g. Filing instructions. The weapon record book will be kept with or in close proximity to the weapon to which it is assigned. In order to provide more positive control and to reduce chance of loss, it is permissible to store Weapon Record Books in a central location at the company level when in a garrison environment. In the event that either Part I or Part II become filled, a new Part I or II will be opened. The old Part I or II will then be stapled to the cover of the new Part I or II.

Note: If entries are currently being made in previous editions of the Weapon Record Book, continue to use the old Weapon Record Book until it is filled, at which time a revised (5-75) Weapon Record Book will be opened.

Chapter 2

SIGHTING EQUIPMENT

2-1. M4 SIGHT

a. Introduction. Your skill in placing mortar rounds where you want them to go will depend a great deal on your knowledge of the M4 sight (fig 2-1) along with the associated sighting equipment which is used with the 60-mm mortar. The sight is used to lay the mortar for deflection (left or right) in mils and elevation (up or down) in degrees.

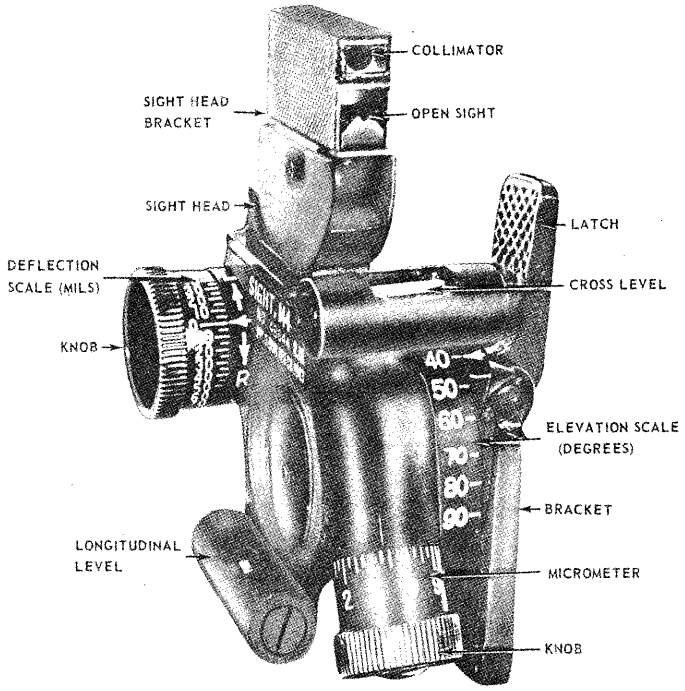


Fig 2-1. M4 sight.

(1) Deflection measures the horizontal (left or right) angle from a given index line (fig 2-2). This line is formed by positioning an aiming post near the mortar position.

(2) Elevation measures the vertical (up or down) angle from a level plane passing through the sight unit (fig 2-3).

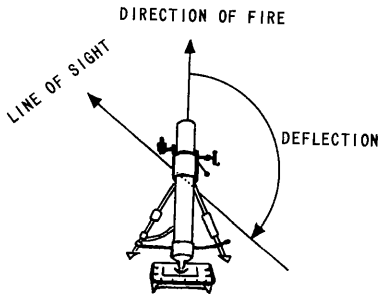


Fig 2-2. Deflection.

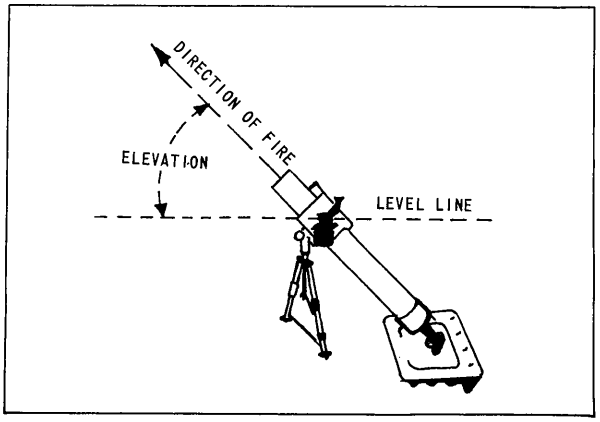


Fig 2-3. Elevation.

b. Nomenclature and description.

(1) Nomenclature (fig 2-4). The sight consists of a collimator, elevation and deflection mechanisms, and longitudinal and cross levels. All are supported by a bracket with a dovetailed base which fits into a slot in the mortar yoke and latches in place. An open sight is provided, but it is used only when the collimator is broken. The deflection and elevation scales indicate deflection and elevation when the level bubbles are centered (measured in true vertical and horizontal planes). The collimator is the direction-sighting device of the sight and consists of a vertical white line in an opaque field all inclosed in a rectangular tube. When the sight is level, the white line in the collimator measures the same deflection between the line of sight and the direction of fire as is shown on the deflection scale on the sight. The bracket upon which the collimator and the open sight are mounted can be pivoted so that the assembly may be moved in elevation as required to bring the aiming point into the field of view. This motion has no effect on elevation indications. The sight is removed for traveling. A carrying case is provided for it.

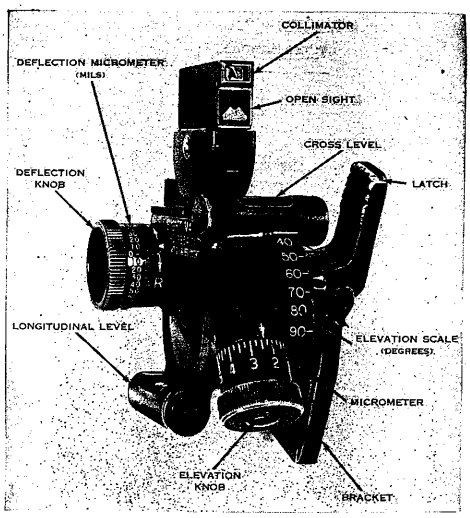


Fig 2-4. Nomenclature of M4 sight.

(2) Detailed description.

(a) Collimator (fig 2-5). The collimator is directly above the open sight, mounted on an adjustable bracket (fig 2-4). The bracket fits on the body head of the sight and is secured by the clamping screw. The collimator has a square-shaped eyepiece opening with a single glass reticle.

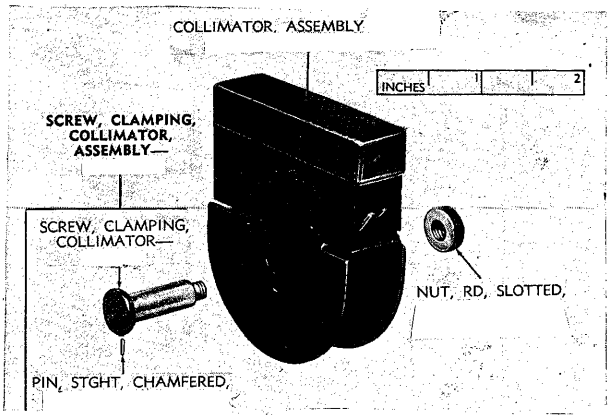


Fig 2-5. Collimator.

(b) Elevation mechanism. The elevation mechanism on the M4 sight consists of an elevation scale and elevation knob with micrometer.

1. Elevation scale. The elevation scale is on the rear of the sight. It is graduated in 10^{o} intervals that range from 40^{o} to 90^{o}. An index is on the right of the scale (fig 2-6).

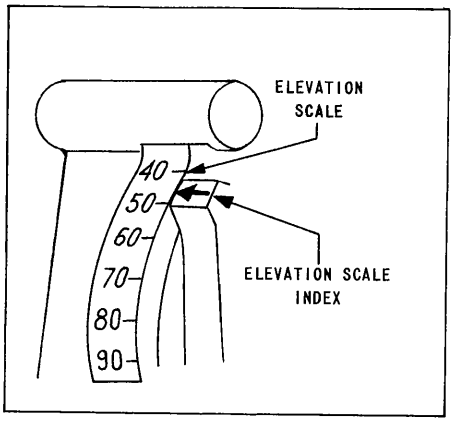


Fig 2-6. Elevation scale.

2. Elevation knob. The elevation knob is to the left of, and below the elevation scale. The knob is used to place elevation readings on the sight. When the elevation knob is turned, the entire sight is elevated or depressed. The elevation knob has an elevation micrometer scale on its side (fig 2-7). This micrometer is graduated from 1^{o} to 10^{o}, with each degree marked in $1/4^{o}$ intervals. One complete turn of the elevation knob moves the elevation scale 10^{o}. Zero on the M4 sight for elevation is 62^{o} because this is approximately halfway between 40^{o} and 85^{o}. In most cases, the highest angle of elevation called for on any firing table is 85^{o}.

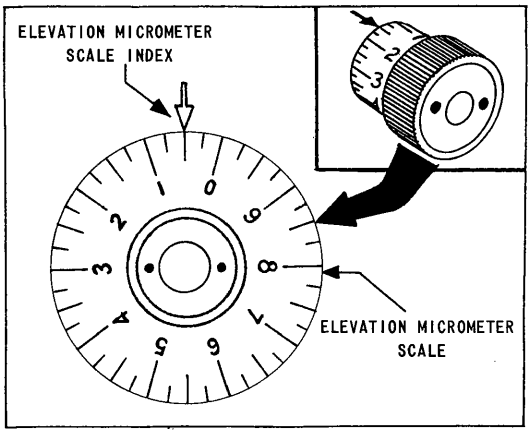


Fig 2-7. Elevation knob and micrometer scale.

(c) Deflection mechanism. This mechanism consists of the deflection knob and scale.

1. Deflection knob. The deflection knob is on the left side of the sight. You turn this knob to make a change in deflection.

2. Deflection scale. The deflection scale is on the deflection knob and is graduated in 5-mil intervals. There are 150 mils to the right and 150 mils to the left of the zero that marks the center of the scale. This gives the gunner a total of 300 mils to move without placing additional aiming stakes. On the body of the sight (fig 2-8) next to the scale there is an index and two arrows. The index is used for adjustments and readings in deflection. The arrows point to the letters L and R indicating left and right. These are to assist the gunner in setting the proper deflection on the sight.

a. To set for left deflection, simply turn the knob toward the letter L until the index which is on the body of the sight points toward the proper setting.

b. To set for right deflection, you simply reverse this procedure. Turn the knob toward the letter R until the index points toward the proper setting.

c. If your round hits left of the target, you set right deflection on the sight. If it hits right, you set left deflection on the sight.

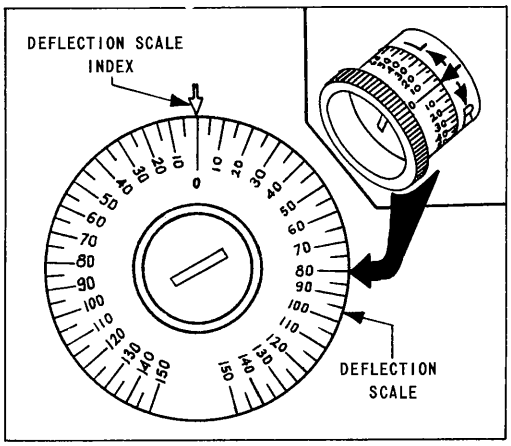


Fig 2-8. Deflection scale.

(d) Longitudinal level (fig 2-9). The longitudinal level is located beneath the deflection knob. This is a bubble-type level in a glass tube. The glass tube is provided with six red lines to center the bubble. The level, when centered, indicates that the elevation of the mortar tube corresponds to the elevation on the sight. The degree of elevation on the sight is set by means of the elevation knob. The longitudinal level is then centered by means of the elevation crank on the bipod.

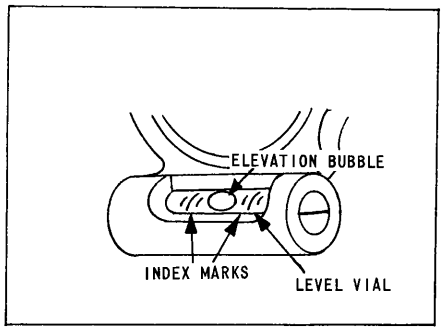


Fig 2-9. Longitudinal level.

(e) Cross level (fig 2-10). The cross-level is located just behind the collimator. It is a glass tube that is partially filled with liquid. There are six engraved lines on the glass tube used to center the bubble. To cross-level properly you must turn the adjusting nut and traversing handwheel and crank at the same time and in the same direction. When the bubble is centered the mortar is level.

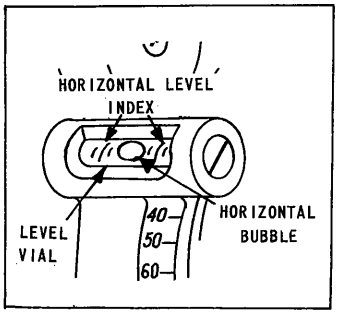


Fig 2-10. Cross level.

2-2. OPERATION OF THE M4 SIGHT

a. Mounting and dismounting. The Squad Leader/Gunner (No. 1 man) automatically checks the seating of the sight in the slot every time he places it on the mortar. His failure to do this may cause a serious waste of time and ammunition during fire for adjustment, because the true angle of elevation, which corresponds to the elevation set on the sight, can only be layed on the mortar when the sight is latched securely.

(1) The following procedure is used in checking to see that the sight is properly seated (fig 2-11): The gunner mounts the sight on the mortar and then places his left index finger against the sight slot and underneath the body of the sight. With his left thumb extending over the cross level and the remaining fingers of his left hand grasping the under portion of the sight body, he attempts to lift the sight out of the slot. When the sight has been properly inserted, the hook on the latch continues to engage the notch in the sight slot.

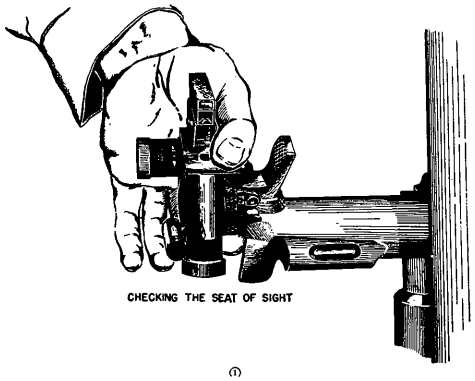


Fig 2-11. Checking the seat of sight.

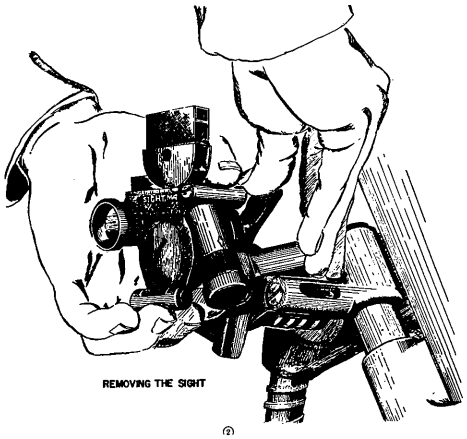


Fig 2-12. Removing the sight.

(2) To prevent damage to the sight by recoil of the mortar before the baseplate is thoroughly seated, the sight is removed before firing each of the first three rounds. The gunner removes the sight carefully to avoid disturbing the lay of the mortar.

(3) To remove the sight, follow this procedure (fig 2-12): From a standing position, the gunner places the fingers of his left hand on the sight in the same manner as for checking the seating of the sight. With his right thumb, he exerts pressure on the knurled portion of the latch and places the remaining fingers of his right hand on top of the yoke. The upward pressure of his left hand is counteracted by the pressure exerted on the yoke with the fingers of his right hand. This method causes the least disturbance in the lay of the mortar.

(4) To place the sight in the carrying case, set the deflection at zero and the elevation at 40^{o}, place the sight in the carrying case and latch it.

b. Sighting. To sight with the collimator:

(1) Place your eyes from 3 to 10 inches to the rear of the collimator.

(2) Adjust your vision so that at the same time you look into the closed collimator sight, you look over the top of the collimator to see your aiming point. You will see the aiming point and the white line in the collimator at the same time as shown in figure 2-13. When the sight is properly alined, the white line is along the left edge of your aiming point.

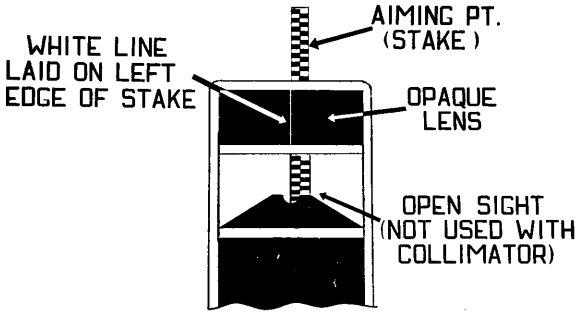


Fig 2-13. Collimator of M4 sight showing the correct sight alinement.

(3) The collimator may be pivoted to the front or rear if the aiming point is on higher or lower ground than the mortar. By pivoting the collimator to the front or rear, you can bring the aiming point into your field of vision.

c. Setting the sight for deflection. The deflection is placed on the sight before the elevation. The procedure for placing deflection on the sight is as follows:

(1) To place a right deflection on the sight, the gunner turns the deflection knob in the direction of the arrow pointing toward R until the arrow pointing at the scale is opposite the desired deflection. To place a left deflection on the sight, he turns the knob in the direction indicated by the arrow pointing toward L until the arrow pointing toward the scale is opposite the desired deflection.

(2) The deflection placed on the sight for the initial fire command is the deflection announced in the command. The deflection announced in all subsequent commands must be applied algebraically to the deflection setting on the sight. For example, the deflection setting on the mortar is left 30 mils. The deflection element of a subsequent command is given as RIGHT 50. The next deflection to be placed on the sight, therefore, is right 20 mils.

d. Setting the sight for elevation. The elevation is set on the sight after the deflection when the command indicates a deflection change. The gunner obtains elevations from a firing table to correspond to the range in meters as announced in the fire commands. To set the sight for elevation, he turns the elevation knob, which in turn, operates both the elevation and micrometer scales. Thus, scales are set correctly to obtain the desired elevation. For example, to place an elevation of 65^{o} on the sight, turn the elevation knob until the arrow opposite the elevation scale is midway

between the 60° and 70° marks, and the 5° mark on the micrometer scale is opposite the micrometer scale index arrow. The gunner is careful to prevent making a 10° error, for instance setting the elevation scale at 55° or 75° in this example.

e. Summary of sight operation.

(1) Remove the sight from the carrying case and insert the dovetailed base of the bracket in the slot of the mortar yoke. When it is fully inserted, the latch will snap into place securing the sight in position. Check to see that the sight is firmly seated and latched.

(2) Set the deflection and elevation to the desired values. Deflection is measured in mils, elevation in degrees. Obtain elevation data from the pertinent firing tables.

(3) Operate the elevating crank, centering the bubble in the longitudinal level. Center the cross-level bubble with the adjusting nut. Then traverse until the vertical line of the collimator is on the left edge of the aiming stake and, at the same time, move the adjusting nut in the same direction as the traversing handwheel to keep the cross level bubble centered. The mortar is now layed correctly for elevation and direction.

(4) The alinement of the levels, pivots, and collimator is made at the factory. Ordinarily, facilities are not available for verification in the field, therefore adjustment is not permitted by the troops.

2-3. CARE AND PRESERVATION

a. The sight is a rugged instrument; however, it cannot stand abuse or rough handling because inaccuracy or malfunctioning results from such mistreatment. Avoid striking or otherwise injuring any part of the sight, particularly burring or denting the locating surface of the sight bracket and mortar yoke.

b. When not in use, keep it in the carrying case. Keep the sight as dry as possible, and never place it in the carrying case while wet.

c. If a sight fails to function correctly, turn it in to ordnance for repair.

d. Using troops are not permitted to paint the sight.

e. Elevation and deflection mechanisms have stops limiting their motion. Do not attempt to turn the knobs beyond these limits.

f. Using troops are not permitted to disassemble the sight.

g. Keep the optical parts of the collimator clean and dry. Use lens tissue paper for wiping off these parts. The use of polishing liquids, pastes, or abrasives is prohibited for polishing the optical parts.

h. Occasionally, oil the exposed moving parts of the sight with a small quantity of special preservative lubricating oil or lubricating oil for aircraft instruments and machineguns. Keep the dovetailed surface of the bracket and the mating surface of the mortar yoke thinly coated with special preservative lubricating oil or light rust-preventive compound. To prevent accumulation of dust and grit, wipe off any excess lubricant that seeps from moving parts.

2-4. M10 AIMING POSTS

Two M10 aiming posts are supplied with each mortar. They are 25 1/2 inches long and constructed as shown in figure 2-14. Use the aiming posts in determining the initial direction for laying the mortar by the direct alinement method. Use the graduated mil scale in determining mil widths. Hold the mil scale 18 inches from your eye when measuring mil widths. In addition to the issued aiming posts, it is advisable to have available with the squad equipment at least three improvised wooden aiming stakes with the following approximate dimensions: 2 inches x 1 inch x 3 feet.

Use the M10 aiming posts as base stakes, and use the improvised stakes as the additional aiming stakes. Whenever the M10 aiming post is not available, use improvised aiming stakes.

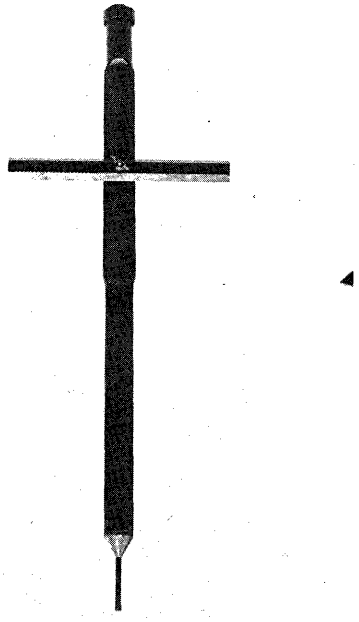


Fig 2-14. M10 aiming posts.

2-5. M37 INSTRUMENT LIGHT

The M37 instrument light (fig 2-15) is used with the M4 sight for night firing. It consists of a battery case with a built-in rheostat for controlling the degree of illumination of the collimator; a single 1 1/2-volt battery BA-30, or equivalent; a hand light; a collimator light; and a clamp for attaching the case to the right bipod leg. The hand light is used to illuminate the scale and levels of the sight. When the hand light is not in use, it is mounted on the clip on the battery case. To lay the mortar at night, turn on the collimator light. This causes the white line of the collimator to become visible. Then lay the white line of the collimator on the thin green vertical line of the aiming post light.

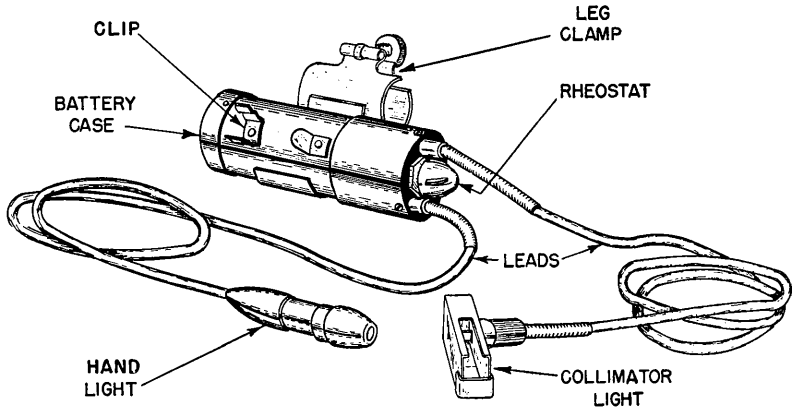


Fig 2-15. M37 instrument light.

2-6. SIGHT EXTENSION

The sight extension is designed to permit the gunner to take up a prone position while laying the mortar. The extension has a bracket that fits into the sight slot on the mortar yoke, and a latch that holds it securely in place. When the extension is attached to the mortar, the M4 sight is inserted into a slot at the bottom of the extension. It is held in place by the sight latch. This slot is similar to the sight slot on the mortar. The over-all length of the extension is approximately 8 inches.

2-7. M14 AIMING POST LIGHT

a. The M14 aiming post light (fig 2-16) is provided for night firing. It consists of a battery case, a light bulb, a switch, a hook, and a green filter. When the light is turned on, a thin green light appears on the lens.

b. The battery case is the main assembly for the other parts. The case holds one flashlight battery (BA-30).

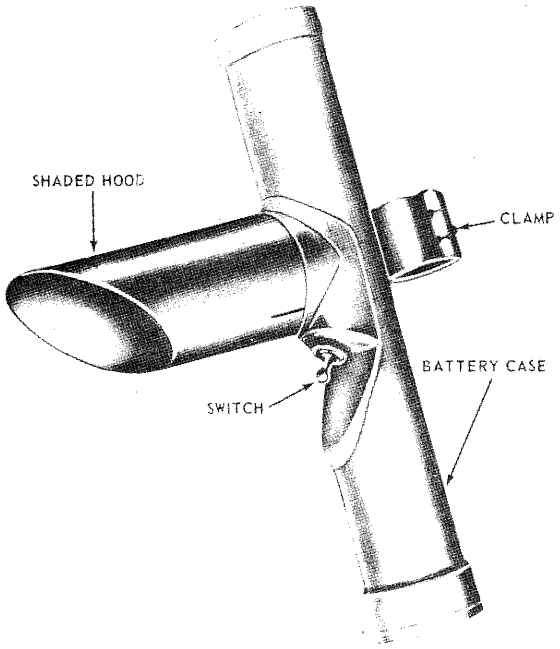


Fig 2-16. M14 aiming post light.

Chapter 3

AMMUNITION

Section I. MORTAR ROUNDS

3-1. GENERAL

a. Description. Mortar ammunition is semifixed complete. Semifixed ammunition is characterized by accessible propelling charges. This allows the charge to be varied, and gives greater flexibility in trajectory. Part of the complete propelling charge for a mortar consists of bags or sheets of a highly combustible material which are attached to the fin assembly. Ammunition is complete if it has all the necessary components to fire and for mortars such ammunition is called a cartridge.

b. Classification. Ammunition used with the 60mm mortar is classified according to its use as service, target-practice, and training ammunition.

(1) Service ammunition is fired in combat. It may be high explosive (HE), white phosphorous (WP), or illuminating (ILLUM).

(2) Target-Practice (TP) is used in training forward observers. The shell is filled with a small black powder pellet and plaster of paris.

(3) Training ammunition is used in training mortar crews. It has an inert filler and is propelled by an ignition cartridge only.

c. Identification.

(1) Ammunition can be identified by labels and colors. Each cartridge is clearly labeled with the filler, the type, and the lot number. A lot number is assigned to each lot of ammunition produced by a manufacturer. Ammunition of the same lot should be stored together and fired together. Do not mix lots. Each category of ammunition has a distinctive color.

(2) Color codes of chemical ammunition have been modified by NATO agreements. Until ammunition manufactured before this agreement has been expended, the user must know both codes (fig 3-1). OD in the color code indicates olive drab (dark green)

CARTRIDGE	OLD COLOR CODE	NATO STANDARD CODE
High Explosive (HE)	OD w/yellow labeling	OD w/yellow labeling
Smoke (WP) (FS)	Grey w/yellow labeling	Light green w/red labeling
Illuminating (ILLUM)	Grey w/white labeling	White w/black labeling
Practice (TP)	Blue w/white labeling	Blue w/white labeling
Training	Black	Blue w/white labeling

Figure 3-1. Ammunition color code.

d. Body. The body of the 60-mm mortar round is used to hold the filler and provide a place to attach the fuze and shaft of the fin assembly. The body is made of various metals and in different shapes depending on the type of round. In addition to holding the filler, the body of high-explosive rounds will produce fragments when the round detonates.

e. Fuze. The fuzes used on mortar rounds are made to cause the fired round to function at the desired time or place. The fuzes used with the 60-mm mortar ammunition are classified as impact and fixed-time.

(1) Impact fuzes. These fuzes will cause the round to function when it comes in contact with an object. The 60-mm mortar uses point detonating impact fuzes. Point detonting fuzes function immediately upon impact and are called superquick (SQ). The superquick-type fuze is used with the high-explosive, smoke,and practice rounds.

(2) Fixed-time fuzes. These fuzes cause the round to function at a prescribed time after the round is fired. The fixed-time fuze is used only with the illuminating round.

CAUTION: Fuzes should NOT be disassembled. Any attempt to disassemble fuzes in the field is dangerous and prohibited.

f. Fin assembly. The fin assembly stabilizes the round in flight and holds the propellant charge.

g. Propellant charge. The propellant charge is made up of a primer, an ignition cartridge, and bundles of propellant called increments. The primer is in the base of the ignition cartridge, which is in the base of mortar round. The increments are attached to the fin assembly. The increments are made of a propellant known as ballistite. Some increments are issued as bundles of square sheets enclosed in a plastic bag. Another type of increment is in flake form enclosed in a paraffin wax-treated cloth bag. At present, all increments used with 60-mm mortar ammunition are of the square sheet plastic-bag type.

h. Functioning of a round. A complete mortar round is made up of all the components necessary for firing. A round is inserted in the mortar barrel with the fin assembly down. When the round is released, its weight will cause the round to slide down the inside of the barrel. When the mortar round reaches the bottom of the barrel, the primer of the ignition cartridge strikes the firing pin if the firing selector is set on DROP FIRE. The primer ignites the ignition cartridge which in turn ignites the increments. This rapid burning produces gas pressure which propels the round out of the barrel. The number of increments may be changed in order to vary the range of the round. The fin assembly acts to stabilize the round in its flight and to cause the round to strike or approach the target, fuze end first. The round is considered boresafe because the explosive train is interrupted within the fuze assembly. After the round has been fired, the explosive train (fig 3-1) within the fuze will aline itself. The method of detonating the round will depend on the type of fuze. The fuze will function at a prescribed time, or upon impact.

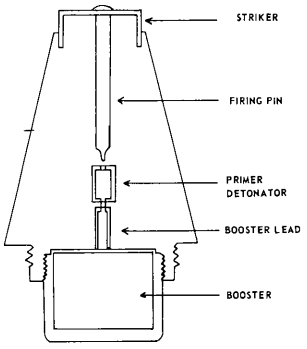


Fig 3-1. Fuze explosive train.

3-2. TYPES OF 60-MM MORTAR ROUNDS

a. Introduction. Ammunition authorized for use with the 60-mm mortar is listed in figure 3-2. Because of its stabilizing fins, this ammunition, even though fired from a smooth bore mortar, is stable in flight and strikes nose end first. The propelling charge, consisting of an ignition cartridge and propelling increments, is attached to the fin shaft or within the fin blades. The ignition cartridge is inserted in the base of the fin shaft. The increments are removable. When fired, the projectile carries the fired ignition cartridge case with it. The mortar is then ready for the next round.

60MM MORTAR AMMUNITION

TYPE & MODEL	APPROX. WEIGHT IN LBS.	FILLER	FUZE		COLOR AND MARKINGS	APPROX. MAX. RANGE IN METERS	BURSTING AREA IN METERS	USES
			MODEL	ACTION				
Shell, HE M49A2 and M49A2E2	3	TNT .34 lbs.	M525	SQ	Olive drab w/yellow Markings	1800	20 X 10	Personnel
Shell, Smoke (WP) M302 and M302E1	4	White Phosphorous .75 lbs.	M527	SQ	Grey w/yellow or Light Green /red Markings	1500	10	Screening, signaling, cas., Incendiary action
Shell, Illuminating M83A3	4.15	Parachute Flare	M65A2	Time (Fixed) 15 sec.	Grey or White w/black Markings	1000	Burning time 30-35 Secs. Candle power 330,000 Illuminates Approx. 500 meter radius (½ grid square)	Illumination
Shell, Prac- M50A2	3	Inert	M525	SQ	Blue w/ White markings	1800	0	Practice and Training of observers
Shell, Training M69	4.5	Solid	None	None	Black or Blue w/white Markings	225	0	Training of Gun Squads

NOTE: Training Shell is fired with ignition cartridge only.
All other 60mm ammunition has 4 propelling increments attached when issued.

Fig 3-2. Authorized rounds.

b. Description of rounds.

(1) M49A2 (M49A2E2 and M49A4) high-explosive round (fig 3-3).

(a) This round is the standard high-explosive projectile provided for the 60-mm mortar. It is used to a much greater extent than any of the other authorized rounds. It is used chiefly against personnel and is very effective in producing casualties because the fragments of the shell fly in all directions at the instant the shell hits the ground or any other solid object. It has a casualty-producing radius of approximately 20 meters wide and 10 meters deep.

(b) This round consists of a forged steel or pearlitic malleable iron projectile body, a composition B bursting charge, a PD fuze, a 2-inch fin extension and fin assembly M2 with propelling charge.

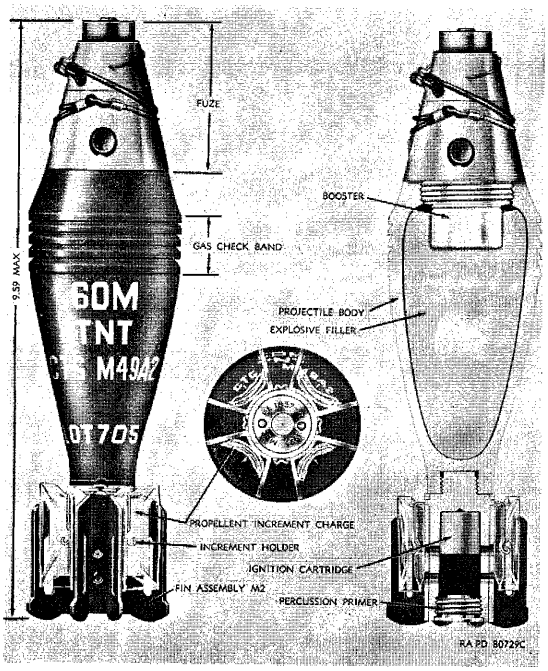
Caution: The firing table for the M49A2 and other rounds in the M49 series differ. Refer to the proper firing table before firing.

(c) Physical data.

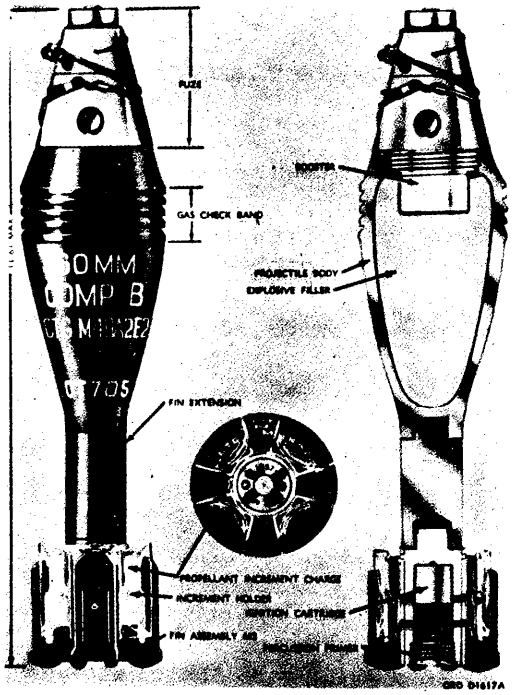
Weight of complete round. . . . . 3.20 lb
Length of complete round. . . . . 11.61 in.

(d) Ballistic data.

Charge	Time of Flight sec.	Maximum range M
Charge 0 (ignition cartridge only).	8.2	250
Charge 1 (ignition cartridge plus 1 increment charge).	12.4	625
Charge 2 (ignition cartridge plus 2 increment charges).	15.6	1050
Charge 3 (ignition cartridge plus 3 increment charges).	18.2	1450
Charge 4 (ignition cartridge plus 4 increment charges).	20.6	1800



HE, M49A2



HE, M49A2E2

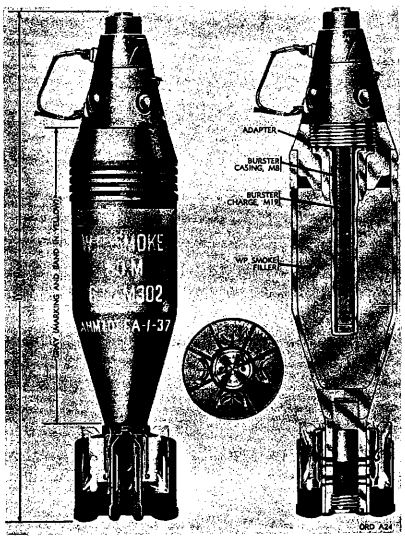
Fig 3-3. HE rounds.

(2) M302A1 (M302E1 and M302A2) smoke round.

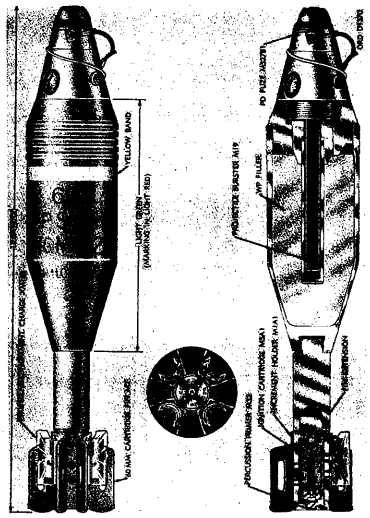
(a) The smoke round is used as a screening, signaling, casualty-producing, or incendiary agent. This round (fig 3-4) is similar in design to the HE shell. It has a longer body, a thinner shell, and a filler of white phosphorous. The bursting charge is designed to burst the shell casing and scatter the white phosphorous which ignites when exposed to air. The round has a casualty-producing radius of 10 meters.

(b) Ballistic data.

Charge	Time of Flight (sec.)	Maximum range M
Charge 0 (ignition cartridge only)	6.8	175
Charge 1 (ignition cartridge plus 1 increment charge)	10.5	475
Charge 2 (ignition cartridge plus 2 increment charges)	13.4	825
Charge 3 (ignition cartridge plus 3 increment charges)	15.9	1150
Charge 4 (ignition cartridge plus 4 increment charges)	18.1	1425



Cartridge WP, M302.



Cartridge WP, M302E1.

Fig 3-4. Smoke round.

(3) M50A2E1 (M50A3) practice round. The practice round differs from the HE round only in color, bursting charge, and casualty-producing effect. It is used in training and is just as effective as the HE round for this purpose because of identical ballistic qualities. The shell is blue and has a small black powder spotting charge as the filler instead of TNT.

(4) M69 training round.

(a) This round (fig 3-5) is provided for training mortar crews in loading and firing the 60-mm mortar. The round is completely inert and has no fuze. The fin assembly is detachable and can be replaced if damaged during firing. Ignition cartridges are issued separately and can be reloaded into the fin assembly for further use. The ignition cartridge is the only propelling charge used with this round.

(b) Data:

Weight of complete round	4.43 lb
Weight of projectile, w/o fin	3.95 lb
Length of complete round	7.72 in.
Length of projectile, w/o fin	5.55 in.
Maximum range	225 meters

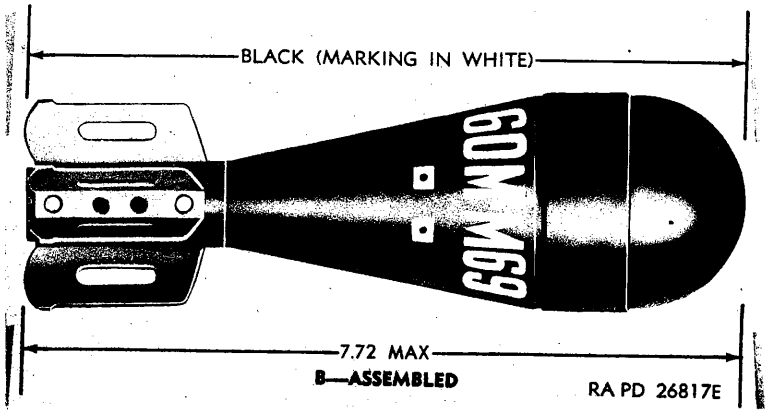


Fig 3-5. Training round, M69.

(5) M83A3 illuminating round.

(a) The illuminating shell (fig 3-6) is used in night missions to assist ground troops in observation. It is made up of four major parts--a body tube assembly, an illuminant assembly, a parachute assembly, and a tail assembly. The shell is also equipped with four propelling charges.

(b) The illuminating shell is equipped with the M65A1 time fuze. The fuze ignites the quick match (after the safety wire is removed and the round is fired), and the quick match then ignites the black powder charge. This black powder charge expels the parachute and illuminant charge assemblies from the shell in approximately 15 seconds and, at the same time ignites the illuminant charge. The illuminant charge burns for at least 30 seconds with a minimum of 330,000 candle power. While in the air, the illuminant charge drops at a rate of 10 feet per second.

(c) Physical data:

Weight of complete round . . . . . 4.15 lb
Length of complete round . . . . . 14.28 in.

(d) Ballistic data:

Charge	Effective Illuminating Time (sec.)	Horizontal range M	Height of burst M	Elevation deg	Elevation min
Charge 2 (ignition cartridge and 2 increment charges). . . .	(30-35)	400	148	70	
Charge 2 (ignition cartridge and 2 increment charges). . . .	(30-35)	425	138	68	45
Charge 2 (ignition cartridge and 2 increment charges). . . .	(30-35)	450	127	67	30
Charge 3 (ignition cartridge and 3 increment charges). . . .	(30-35)	775	139	53	45
Charge 4 (ignition cartridge and 4 increment charges). . . .	(30-35)	998	128	45	15

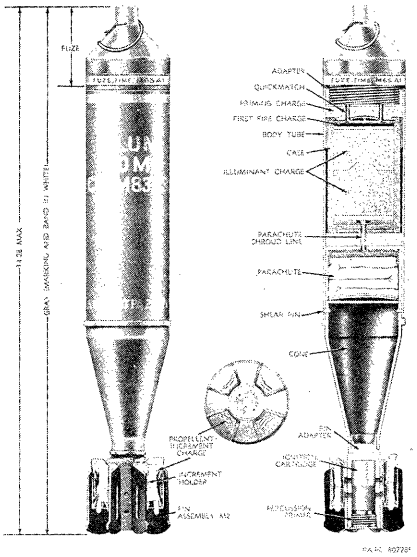


Fig 3-6. Illumination round, M83A3.

3-3. CARE, HANDLING, AND PRESERVATION

a. Ammunition is made and packed to withstand all conditions ordinarily encountered in the field. Nevertheless, since ammunition is adversely affected by moisture and high temperature, give consideration to its protection from these conditions.

b. Complete rounds, being fuzed, are handled with care. The explosive elements in primers and fuzes are particularly sensitive to strong shock and high temperature.

c. Do not break the moisture-resistant seal of the fiber container until the ammunition is to be used. When a large number of rounds (15 or more per squad) are prepared before a combat mission, the rounds may be removed from the containers, and the propelling increments adjusted. Then reinsert the fin assembly of each into the container to protect the propelling charges.

d. Do not attempt to disassemble any fuze.

e. Protect the ammunition carefully from mud, sand, dirt, and water. See that the rounds are free of such foreign matter before firing. When ammunition gets wet or dirty, wipe it off at once.

f. Do not allow the ammunition, particularly the powder increments, to be exposed to direct rays of the sun for any length of time. More uniform firing is obtained when the rounds are at the same temperature.

g. Remove the safety wire from the fuze just before firing.

h. Replace the safety wire into all rounds that have been prepared for firing, but not used. Replace the powder increments that have been removed. Then return the rounds to their original packing and mark them appropriately. Use these rounds first in subsequent firing to keep the number of unpacked rounds to a minimum.

i. DO NOT HANDLE DUDS. Duds are rounds that have been fired,but did not explode. They are extremely dangerous because the fuze is armed and any movement of the round may cause it to explode.

Section II. FUZES

3-4. FUZE, POINT DETONATING, M525A1

The M525A1 fuze (fig 3-7) is provided for use with the high-explosive round M49A2, M49A2E2, and training practice round M50A2. This fuze is a single-action, point detonating, delayed arming, superquick fuze. The fuze consists of a delayed arming head, a body, and a booster cup. It will remain unarmed for 3 seconds after it has left the muzzle of the mortar. This provides safety in handling and firing for the mortar crew.

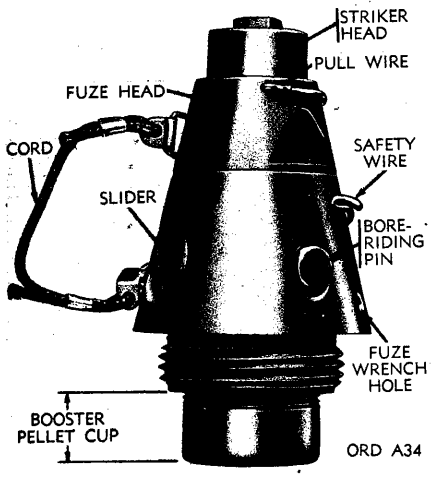


Fig 3-7. Fuze, point detonating, M525A1.

a. Data:

Length (overall) . . . . . 3.50 in.
Weight . . . . . 0.44 lb.

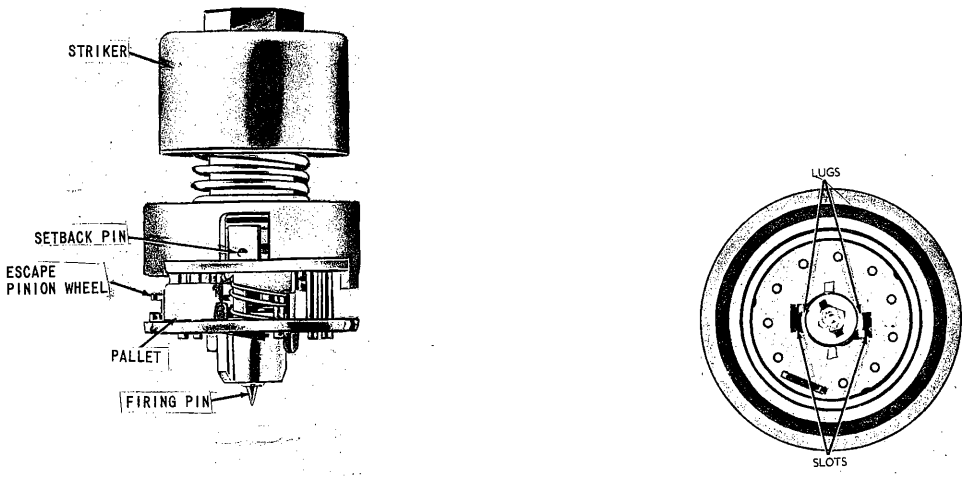
b. Arming system. The arming system is composed of a setback device and a delayed arming mechanism.

(1) Setback device. This device contains the setback pin and spring, the bore-riding pin and spring, and the slider which holds the detonator. There is also a setback pin and spring in the delayed arming mechanism. The detonator is held in an out-of-line position before firing. Setback action from firing causes the setback pin to be withdrawn from the bore-riding pin. The bore-riding pin moves outward and contacts the inside of the mortar barrel. The bore-riding pin is ejected from the fuze as soon as the fuze clears the muzzle of the mortar. The detonator is within the slider which has been held out of line with the firing pin by the bore-riding pin. As the bore-riding pin is ejected from the fuze, the slider, moving under its spring power, moves the detonator into position under the firing pin. The delayed arming system must have functioned before the slider can move.

(2) Delayed arming mechanism (fig 3-8). The delayed arming mechanism is essentially a clock mechanism which is connected to the firing pin by a central gear. The function of the clock mechanism is to rotate the firing pin 1/4 turn after the fuzed round is fired.

(a) Before firing. The firing pin is held in a down position by two lugs (fig 3-8B) on the firing pin. In this position the lugs of the firing pin are under a fixed plate. This plate has two slots that will allow the firing pin to rise when the lugs are alined with them. The detonator end of the firing pin is engaged in the slider. In this position the firing pin acts as a detent to keep the slider from moving the detonator into line with the firing train.

(b) After firing. Setback action from firing unlocks the clock mechanism. Three seconds after the clock mechanism has been unlocked it will rotate the firing pin 1/4 turn counterclockwise. This movement will aline the firing pin lugs with the fixed plate. Then the firing pin spring forces the firing pin up. This causes the firing pin to be withdrawn from the slider. The slider will move laterally under its spring tension and position the detonator in the firing train under the firing pin. This completes arming of the fuze.



A. Side view.

B. Top view.

Fig 3-8. Delayed arming mechanism.

c. Height of burst. The M525A1 fuze will function superquick upon impact with the target. There will be very little ground penetration before the round explodes. In heavily wooded terrain, rounds that strike trees or very dense brush will explode upon impact with these objects.

d. Malfunctions. Malfunctions are almost nonexistent when these fuzed rounds are stored and handled properly. Prolonged storage in damp climates may cause moisture and rust to form within the fuze mechanism. This may prevent normal setback and arming functions. These rounds will not detonate on impact.

e. Preparation for firing. The only preparation for firing is the removal of the pullwire and the safety wire. This should be done just before loading the fuzed round into the mortar. Remove the pullwire first and the safety wire last. The delayed arming mechanism may function upon removal of the pullwire and safety wire. If the fuze makes a buzzing noise when these wires are removed, the delayed arming mechanism has functioned. IN THIS CASE, DO NOT FIRE THE ROUND. Replace the safety wire. When the safety wire is in place and the bore-riding pin is still in position, the round is considered safe to handle and transport.

f. Preparation for storage. Replace the safety wire and the pullwire if they have been removed. Unfired rounds and fuzes should be returned to their original containers for storage or transportation.

g. Safety precautions. This round is considered boresafe, but extremely rough handling and storage under adverse conditions must be prevented. Do not fire a fuzed round if the bore-riding pin becomes unseated when the pullwire and safety wire are removed. Do not attempt to fire a round whose fuze is dirty, wet, or rusty. Make sure you have overhead clearance before firing. Do not attempt to disassemble any fuze or fuzed round.

3-5. FUZE, POINT DETONATING, M527B1 (fig 3-9)

This fuze is used with the smoke round, WP M302. With the exception of a smaller booster for use with the smoke round, the M527B1 fuze is identical to the M525A1 fuze.

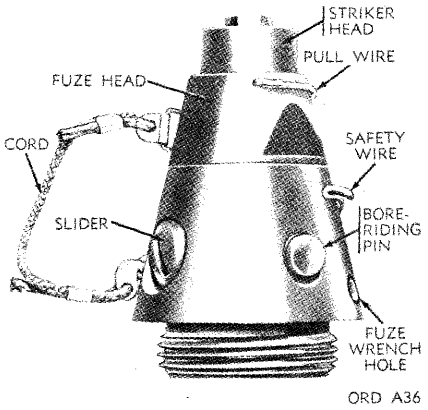


Fig 3-9. Fuze, point detonating, M527B1.

a. Arming system. Same as for M525A1.

b. Height of burst. Same as for M525A1.

c. Malfunctions. Same as for M525A1.

d. Preparation for firing. Same as for M525A1.

e. Preparation for storage. Same as for M525A1.

f. Safety precautions. Same as for M525A1.

NOTE: Rounds issued with the M52 and M82 fuzes are issued for combat emergency only and should not be fired over the heads of friendly troops.

3-6. FUZE, TIME (FIXED), M65A1 or M65

Note: The letters shown in parentheses below refer to figure 3-10.

a. General. The fuze M65A1 (fig 3-10) is a fixed-time fuze and used with the 60-mm illuminating round to obtain the delay in functioning required for the most effective illumination. It differs from the adjustable powder-train types in that the burning time is fixed at approximately 15 seconds, and therefore does not have a movable time ring or require adjustment. This delay permits the round to be at its optimum range and height before the illuminant begins to burn. The fuze M65A1 differs from the fuze M65 in the following respects: the striker is longer; the body is recessed beneath the time-train ring to protect the felt pads which separate the body and ring; the fuze wrench holes in the body are replaced with two fuze wrench slots cut into the lower flange on the body; the time-train ring is slightly heavier; and the quick match is replaced by a black powder pellet (F).

b. Data.

Length:

Visible	2.06 in.
Overall	2.54 in.
Weight	0.74 lb

c. Description. The time train is a powder-train type consisting of a primer (E), black powder pellet (F), a time-ring charge (H) loaded for a prescribed time of burning, a body pellet (J) and an expelling charge (L). Powder elements other than the black powder pellet (F) and time-ring charge are held in a die-cast body. The black powder pellet and time-ring charge are assembled in the time-ring (G) which is essentially a large washer grooved and drilled to hold the charges. A head (D) seating the striker (C) screws onto a threaded neck on the body (K), holding the time-ring in a fixed position. A safety (cotter) pin (A) and a shear wire (B) pass through the head and striker. The safety pin provides positive safety during handling prior to firing. The shear wire holds the striker at rest until broken or bent by setback forces on firing.

d. Functioning. Upon firing, setback causes the striker to move rearward with sufficient force to break the shear wire and strike the primer. The flame from the primer ignites the black powder pellet, which in turn, ignites the time-ring charge. After the flame from the time-ring charge has completed its circle about the time-ring, it ignites the body pellet. The body pellet then ignites the expelling charge. Flame from the latter passes through the apertures in the expelling charge retainer disk (M), igniting the illuminant in the round.

e. Preparation for firing. There is no preparation except the removal of the safety (cotter) pin, just prior to firing.

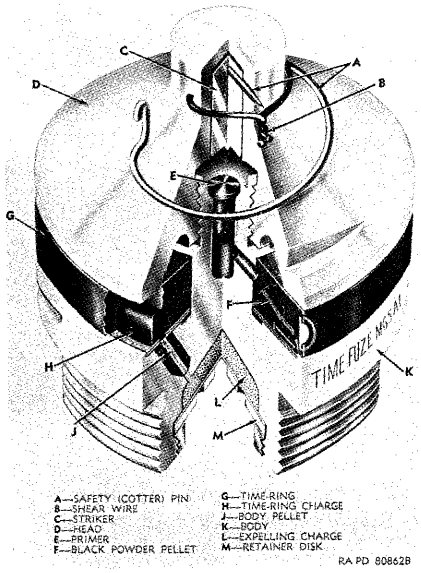


Fig 3-10. Fuze, time (fixed), M65A1.

Section III. PROPELLING CHARGES, FIRING TABLES, AND STORAGE OF AMMUNITION

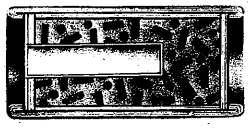
3-7. PROPELLING CHARGES

a. Introduction. The propelling charges used with 60-mm mortar ammunition consists of a primer assembly, an ignition cartridge, and bundles of propellant known as increments.

(1) Primer assembly (fig 3-11). The primer assembly used with the 60-mm mortar ammunition is like the primer used with small-arms ammunition. The assembly consists of the primer adapter and the primer itself. The adapter holds the primer and is threaded so that it may be screwed into the fin assembly. The purpose of the primer is to ignite the ignition cartridge. In some types of ignition cartridges, the primer is fixed to the cartridge.

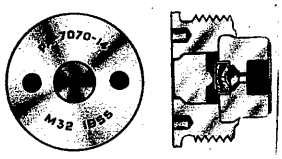
(2) Ignition cartridge (fig 3-11). The ignition cartridge is a paper tube containing flaked propellant. The ignition cartridge fits into the hollow shaft of the fin assembly in front of the primer. The ignition cartridge used with the M69 training round is complete and contains the primer. The purpose of the ignition cartridge is to provide an initial propelling charge. The cartridge will also ignite the increments if they are used. The ignition cartridge is used as the only propelling charge for extremely short ranges (charge 0) for some types of ammunition.

(3) Increments. The increments used with the 60-mm mortar ammunition are manufactured in the form of square sheets. The number of thicknesses of sheet propellant is determined by the weight of the increment needed. Each increment is individually sealed in a plastic bag. The XM181 is the increment used with the 60-mm mortar ammunition (fig 3-11). The increments are removable and may be varied in number as required for adjusting fire for different ranges. The increments produce the gas pressure necessary to send the round to the target.



CARTRIDGE, IGNITION: M5A1

CARTRIDGE, IGNITION: M1



PRIMER, PERCUSSION: M32

INCREMENT M3A1

INCREMENT FOR 60-MM MORTAR

Fig 3-11. Ignition cartridges, primer, and increments for 60-mm mortar ammunition.

b. Use of propelling charges. Different propelling charges are used with different types of mortar ammunition. Do not attempt to use propelling charges that were manufactured for other types of ammunition. Increments should be protected from rain and moisture because short and unpredictable ranges result if they get wet. The following is a list of mortar rounds and their intended propelling charges:

(1) M49A4, M50A2E1, M83A3, M302A1 rounds. The propelling charge consists of a primer, an ignition cartridge and four propellant increments XM181. These increments are inserted between the fin blades and held in place by increment holders.

(2) M69 training round. A primer and ignition cartridge (M4) is the only propelling charge used with this round. The M4 ignition cartridge is similar to a shotgun shell, but does not contain shot pellets. It contains the primer and is loaded with flaked propellant. This cartridge is slightly bulged to hold it inside the fin assembly. Separate primer and cartridge assemblies may be used if the fin cavity has been threaded to receive the primer.

c. Loading ignition cartridges. The training round M69 is a solid cast-steel projectile which may be recovered and reused after it is fired. Additional fin assemblies and ignition cartridges are issued for this purpose. A wooden device for loading and unloading ignition cartridges into the fin assembly and unloading the fired cartridges is very helpful (fig 3-12). Fin assemblies issued for use with the M69 training shell may be reloaded with this loading device. This process is loading and unloading.

(1) Loading. The M4 ignition cartridge is used with the M69 shell. This ignition cartridge is slightly oversize at the base to insure that this cartridge remains in the fin assembly during loading and firing the mortar. The M4 ignition cartridge is difficult to seat in the fin assembly by hand. These cartridges may be easily and safely loaded with the loading device (fig 3-12). The cartridge chamber within the fin assembly must be thoroughly cleaned before loading. You must avoid tapping or striking the primer of the ignition cartridge during the loading process. Striking the primer may detonate the ignition cartridge and cause serious injury. The live ignition cartridge must be fully seated in the fin assembly.

(2) Unloading fired ignition cartridges. Unloading fired ignition cartridges is much easier if the fin assembly is modified before use.

(a) Modifying fin assembly. To modify the fin assembly it is necessary to bore a 3/8-inch-diameter hole through the threaded stud of the fin assembly. Drill this hole parallel with the long axis of the fin assembly (fig 3-12). This permits removal of the fired ignition cartridge with a 20 penny nail or spike of similar size.

(b) Removal of fired ignition cartridge. To remove fired ignition cartridges, unscrew the fin assembly from the base of the training shell. Place the fin assembly on a block of wood 4 by 4 by 2 inches (fig 3-12). There should be a hole, 1 inch in diameter, drilled through the center of this block to receive the fired cartridge. Place the nail or spike in the open (bored) end of the fin assembly and drive the fired ignition cartridge out of the fin assembly.

d. Safety precautions. The following safety precautions must be followed when loading and unloading ignition cartridges:

(1) Do not unload a live ignition cartridge from the fin assembly. Ignition cartridges that fail to fire should be turned into proper ordnance personnel for disposal.

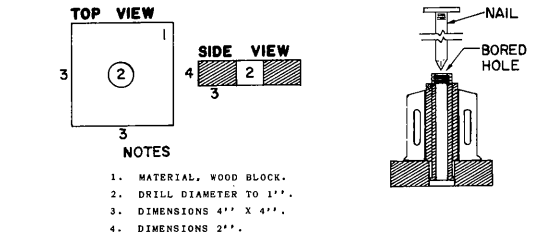
(2) Do not tap or strike the primer.

(3) Do not use ignition cartridges in weapons NOT intended for their use.

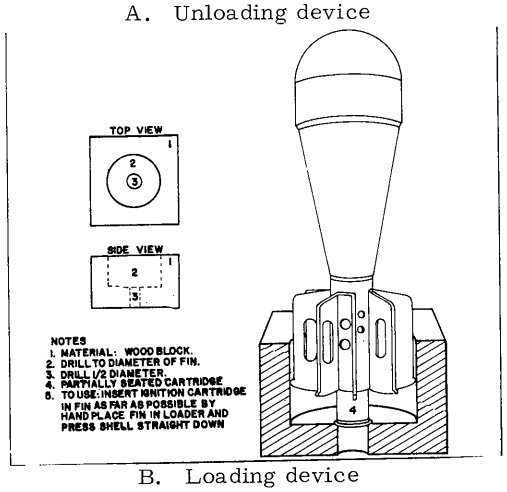
(4) Check that the chamber and threads of fin assemblies are thoroughly cleaned before reloading ignition cartridges. Clean if necessary.

(5) Do not attempt to fire reloaded rounds unless the fin assembly is fully seated on the projectile. Improper seating of the fin assembly to the training shell may cause a rupture in the shell base when the round is fired.

(6) Do not use fin assemblies that are broken, bent, or cracked. Only reload fin assemblies that are in perfect condition. Assemblies that have a missing or bent fin are very erratic in flight.



A. Unloading device


TOP VIEW
SIDE VIEW
NOTES
1. MATERIAL: WOOD BLOCK.
2. DRILL TO DIAMETER OF FIN.
3. DRILL 1/2 DIAMETER.
4. PARTIALLY SEATED CARTRIDGE
5. TO USE: INSERT IGNITION CARTRIDGE IN FIN AS FAR AS POSSIBLE BY HAND PLACE FIN IN LOADER AND PRESS SHELL STRAIGHT DOWN

B. Loading device

Fig 3-12. Loading and unloading devices for training shell M69.

e. Destruction of unused increments. Because of their high combustibility, be careful when igniting them. Do not allow excess increments to accumulate near the mortar position. Remove the increments to a designated place of burning and destroy them as follows: Select a place at least 100 meters from mortar positions, parked vehicles, and ammunition piles. Preburn all dead grass or brush within 100 feet or more around the burning place. Prohibit smoking or fires around ammunition, increments, or the place of burning. Do not burn increments in piles but spread them in a train 1 to 2 inches deep, 4 to 6 inches wide. From this train extend a starting train of single increments laid end to end. End this starting train with not less than 2 feet of inert material (dry grass, leaves, newspapers, etc.). Ignite the inert material.

3-8. FIRING TABLES

Firing tables are provided for each type of shell for the purpose of converting ranges in yards into elevations of the mortar in mils and giving the number of propelling changes. These tables are printed in card form and are included in each ammunition packing box. An example of a firing table is in appendix II of this text.

3-9. STORAGE OF AMMUNITION

Improper storage causes most ammunition malfunctions. Extreme temperatures and moisture causes mortar ammunition to deteriorate very rapidly. This deterioration will normally affect fuzes and propelling charges. Affected fuzes will be duds. Affected propelling charges cause short rounds, or rounds that are very erratic in flight. Two types of ammunition storage are normally used: depot storage and field storage.

a. Depot storage. This is the best type of storage because the temperature and humidity can be controlled. This type of storage is found in ammunition depots that are permanent. Ammunition may be stored for long periods (many years) and still be serviceable.

b. Field storage. Field storage must be temporary, except in areas of dry, moderate temperatures. This type of storage is normally used by mortar crewmen operating in the field. The following storage rules must be followed when operating with mortar ammunition in the field:

(1) Always store ammunition under cover. Permanent cover is best. If permanent cover is not available, cover the ammunition pile with a double thickness of a tarpaulin.

(2) Raise ammunition on dunnage (wood) at least 6 inches from the ground.

(3) Dig suitable trenches to prevent water from flowing under the stack of ammunition.

(4) Store ammunition in its original containers and boxes.

(5) Store WP rounds with their fuze ends up. WP liquefies at temperatures above 100° F. These rounds must be protected against an uneven rehardening of the filler. An air cavity formed on one side of the round will unbalance it and cause instability in flight.

Section IV. DESTRUCTION OF MORTAR AMMUNITION AND MATERIALS

3-10. GENERAL

Situations may arise when time or transportation limitations make it impossible to evacuate all equipment. In such situations, destroy all material which cannot be evacuated so as to prevent its capture and subsequent use by the enemy. If thorough destruction of all parts cannot be completed, destroy those parts essential for the use of the mortar. Ruin or remove all other parts which cannot be easily duplicated by the enemy. Destroy the same essential parts on all like units so as to prevent the enemy's construction of one complete unit from several damaged ones by consolidating the serviceable parts.

3-11. DESTROYING THE MORTAR

The preferred method for destroying the mortar involves the use of two thermite grenades.

a. If there is a necessity to destroy the mortar, the mortar is dismounted and placed flat on the ground, and earth is built up in the vicinity of the yoke and the firing mechanism (fig 3-13).

b. The thermite grenades are then placed in these two areas (on the yoke and the firing mechanism) supported by the build up of dirt, and ignited.

c. This method accomplishes the complete destruction of both the barrel and the firing mechanism, thus rendering the mortar useless.

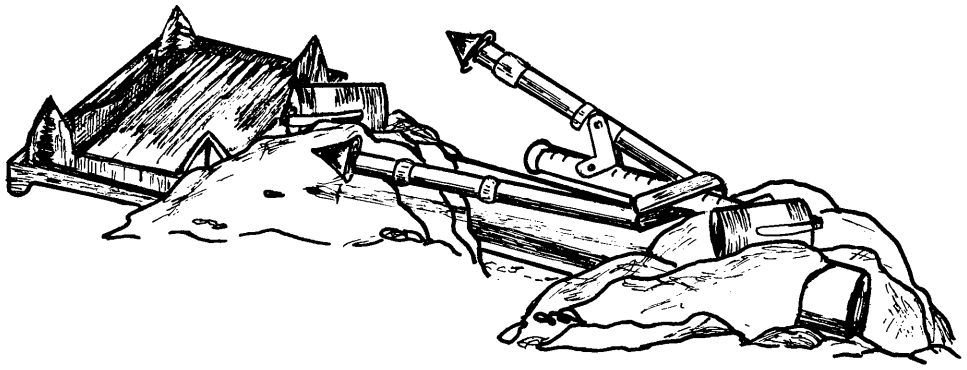


Fig 3-13. Destruction of a mortar.

3-12. DESTRUCTION OF AMMUNITION

Time does not usually permit the deliberate destruction of all ammunition in forward combat areas. When time permits firing to be controlled, the best method of destroying the ammunition on hand is by firing the rounds rapidly in the direction of the enemy. When time and materials are available, destroy large amounts of ammunition by the following methods, which require from 30 to 60 minutes:

a. Destruction of unpacked ammunition.

(1) Stack ammunition in small piles. Stack or pile most of the available gasoline in cans and drums around the ammunition. Throw onto the pile flammable materials such as rags, scrap wood, and brush. Pour the remaining gasoline over the pile. Use enough flammable material to insure a very hot fire. Ignite the gasoline and take cover.

(2) Mortar shells can be destroyed by sympathetic detonation by the use of TNT. Stack the ammunition in two stacks, about 3 inches apart, with the fuzes in each stack toward each other. Place TNT charges between the stacks, using a minimum of 1 pound of TNT for every 10 rounds of ammunition. Detonate all TNT charges simultaneously from your covered position.

b. Destruction of packed ammunition.

(1) Stack ammunition in small piles and cover them with flammable materials, such as rags, scrap wood, brush, or gasoline drums or cans. Pour gasoline over the piles. Ignite the gasoline and take cover.

(2) The destruction of packed ammunition by sympathetic detonation with TNT is not advocated for use in forward combat zones. Satisfactory destruction involves putting the TNT in alternate bundles of ammunition; this is a time-consuming job.

3-13. DESTRUCTION OF FIRE CONTROL EQUIPMENT

All fire control equipment, including optical sights and binoculars, is difficult to replace. Fire control equipment is the last equipment to be destroyed. When evacuation of the equipment is not possible, burn the flammable items such as firing tables, plotting boards, etc. Smash all optical equipment, such as sights, compasses and binoculars.

3-14. DESTRUCTION OF CAPTURED ENEMY MATERIEL

Captured enemy materiel which is not suitable for repair and issue to troops, or which has no technical intelligence value, may be destroyed in the same manner as the equivalent United States equipment. Destroy the enemy materiel before destroying your own equipment.

Chapter 4

TRAINING FOR THE CREW

Section I. INTRODUCTION, MOUNTING, AND DISMOUNTING THE MORTAR

4-1. INTRODUCTION

This chapter describes the duties of each member of the mortar squad in mounting, dismounting, and laying the mortar. Each member must be proficient in crew drill so that he can perform the duties of each member of the squad before firing live ammunition. Some common terms related to the mortar and used in this chapter are defined below:

a. Initial direction. The direction in which the mortar is first pointed. This direction is not necessarily the direction to any particular target. It is usually the direction to the center of the expected sector of fire.

b. Mounting the mortar. To assemble the basic components into a complete unit for firing.

c. Direction stake. An aiming post or some improvised post or stake which is used to establish initial direction with the compass method of laying the mortar.

d. Baseplate stake. A small stake driven into the ground to mark the initial position of the baseplate in the mounting and laying of the mortar.

e. Laying the mortar. To point the mortar in a direction with specified deflection and elevation readings set on the sight unit. The elevation bubble and the cross-level bubble must be centered in their vials.

f. Dismounting the mortar. To disassemble the mortar into its three major components so that they may be carried by the individual squad members.

4-2. MOUNTING

a. The mortar is normally placed in a firing position with the baseplate on top of the ground. Rapid seating is accomplished by loosening the top surface of the ground with an entrenching tool. The baseplate will be fully seated by the recoil of the first two or three rounds. When the mortar is to be mounted on a steep slope or uneven ground, it may be necessary to prepare a horizontal surface upon which to place the baseplate. The command for mounting is ACTION. When this command is given the following steps are to be followed. The asst. gunner will:

(1) Kneel on his right knee to the left of the baseplate with the entire mortar resting on the ground and pointed in the general direction of fire.

(2) Unbuckle the leather strap.

(3) Grasp the mortar with his right hand at the midpoint of the barrel, and raise the unit until the bipod legs can be swung clear of the baseplate with his left hand and allowed to rest on the ground.

(4) Reach over the barrel with his right arm, grasp the legs with both hands just above the feet and pull the legs apart until the spring latch snaps into place. The baseplate is positioned so that the left front corner rests against the baseplate stake and the left edge of the baseplate is alined on the aiming stake.

(5) Place the traversing mechanism in a horizontal position by moving the guide tube to the right, turn the adjusting nut until his left index finger covers the unpainted surface of the leg below the adjusting nut, and tighten the locking nut.

(6) Place the bipod legs about 18 inches in front of the baseplate, with the legs parallel to, and centered on, the front flanges of the baseplate.

(7) Turn the elevating crank 15 turns to center the elevating screw nut.

(8) Center the traversing mechanism.

(9) Place the traversing crank in its operative position.

(10) Remove the muzzle cover.

b. After the A/Gunner has completed setting up the mortar, the gunner will:

(1) Mount the sight on the mortar.

(2) Set the elevation scale at 62° and the deflection scale at zero.

(3) Move the bipod legs until the vertical line of the collimator is alined approximately on the left edge of the aiming stake.

(4) Center the longitudinal bubble, cross-level with the adjusting nut only, and lay accurately for direction by simultaneous operation of the traversing handwheel and the adjusting nut.

(5) Check the lay for elevation.

4-3. DISMOUNTING

a. The command for dismounting is OUT OF ACTION. The steps for dismounting the mortar are as follows. The gunner will:

(1) Remove the sight.

(2) Set the deflection scale at 0 and the elevation scale at 40°.

(3) Place the sight in the sight case and latch the case.

b. After the gunner has prepared the mortar for dismounting, the A/Gunner will:

(1) Replace the muzzle cover.

(2) Center the traversing mechanism and return the traversing crank to its inoperative position.

(3) Turn the elevating crank until the elevating screw is returned completely into the guide tube.

(4) Loosen the locking nut, and move the guide tube over against the left leg. (The locking nut is not retightened)

(5) Lift the left leg and move it over against the right leg.

(6) Support the bipod with his left hand at the midpoint of the legs, reach around the barrel with his right hand and lift the right front edge of the baseplate until the recess fits around the base cap.

(7) Position the legs of the bipod under the baseplate, and allow the entire mortar to rest on the ground.

(8) Fasten the leather strap to secure the bipod and baseplate to the mortar.

Section II. SIGHT SETTING AND LAYING

4-4. SIGHT SETTING

After receiving a fire command, the gunner follows a definite pattern when he applies the announced deflection and elevation to the sight. A keyword that assists him in applying this data to the sight and the mortar is DEED, which stands for deflection, elevation, elevation, deflection. The keyword reminds the gunner of the proper sequence of his actions.

1st: He sets the deflection on the mortar sight.
2nd: He sets the elevation on the mortar sight.
3rd: He elevates the mortar barrel so that the elevation bubble is centered in its vial.
4th: He traverses the mortar so that it is laid for deflection.

D = deflection set on the sight.
E = elevation set on the sight.
E = elevation bubble centered by turning the elevation crank.
D = deflection applied to the mortar by laying on the aiming posts.

4-5. ESTABLISHING INITIAL DIRECTION

The initial direction of fire for a mortar is the center of the sector in which fire is to be placed. This is the direction in which the mortar is first pointed. The initial direction can be determined by the compass, stake and alidade (direct alinement), reference point, map, or parallel line methods. Discussion will be limited to the compass, map, and stake and alidade methods as these are the most commonly used by the members of the mortar squad.

a. Compass (direction) method. This method is used when the sector of fire is not visible from the mortar position. A compass is used to read a direction from the mortar position to the center of the sector of fire. The mortar is then mounted and laid on this direction.

b. Map method. This is used when the sector of fire is NOT visible from the mortar position. On the map, locate the mortar position and the center of the sector of fire. Connect these two points with a straight line and measure the grid direction of the line with a protractor. The direction of this line is the initial direction of fire. The mortar is then mounted and laid on this direction.

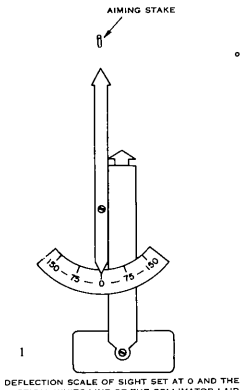
c. Stake and alidade (direct alinement) method. This method is used only when the leader determining the initial direction is on or near the mortar-target line. This is done with the M10 aiming post and alidade. The leader moves to a position, keeping as much as possible on the mortar-target line, where he can observe both the target and mortar position. He makes a sighting to the target and then the mortar position. A baseplate stake is then driven into the ground. The line from the target to the leader to the baseplate stake is the initial direction of fire. The mortar is then mounted, pointing in that direction.

4-6. LAYING FOR DIRECTION

a. Accurate firing is possible only when the vertical line of the collimator is laid on exactly the same position of the aiming point for each round fired at the same target, with the mortar accurately cross-leveled. When an aiming stake is used, the gunner lays the mortar so that the vertical line of the collimator is made to coincide with the left edge of the stake. When an aiming point other than a stake is used, the gunner selects a clearly defined point or vertical edge on which to lay. In aiming, he holds his eye 3 to 10 inches from the lens of the collimator and in such a position that both the aiming point and the vertical line of the collimator are visible. He disregards the open sight unless the collimator is broken.

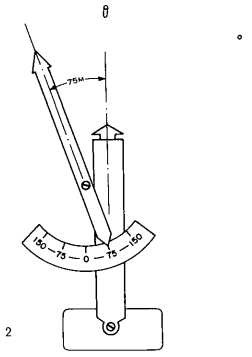
b. When the gunner sets the sight for deflection, the vertical line of the collimator moves off to one side of the aiming stake (fig 4-1 A and B). To place the vertical line of the collimator back on the left edge of the aiming stake, he traverses the mortar (right or left) with the traversing handwheel, cross-leveling simultaneously with the adjusting nut. A deflection set on the deflection scale of the sight (for example, a right deflection) moves the vertical line of the collimator in the opposite direction (left) and requires him to manipulate the traversing

handwheel (to the right) to bring the vertical line back on the left edge of the aiming stake (fig 4-1, C). The two movements of traversing and cross-leveling are combined in a simultaneous operation. In traversing and cross-leveling, the gunner operates the traversing handwheel with his right hand and, at the same time, operates the adjusting nut with his left hand. He turns both hands in the same relative direction to keep the cross-level bubble centered during traverse. To keep the mortar cross-leveled, one turn of the adjusting nut is taken to approximately nine turns of the traversing handwheel. (This ratio varies slightly with different mortars.)



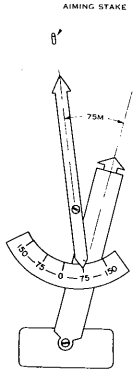
DEFLECTION SCALE OF SIGHT SET AT 0 AND THE VERTICAL WHITE LINE OF THE COLLIMATOR LAID ON THE LEFT EDGE OF THE AIMING STAKE.

A.



SETTING A RIGHT 75 ON THE DEFLECTION SCALE OF THE SIGHT

B.



MORTAR HAS BEEN TRAVERSED (AND CROSS-LEVELED) TO THE RIGHT SO THAT THE VERTICAL LINE OF THE COLLIMATOR IS LAID BACK ON THE LEFT EDGE OF THE AIMING STAKE. THE MORTAR BARREL IS NOW POINTING 75 MILS TO THE RIGHT OF THE AIMING STAKE (AN ANGLE OF 75 MILS HAS BEEN MEASURED TO THE RIGHT).

C.

Fig 4-1. Laying for direction.

c. Before the gunner begins to traverse back to the aiming stake, he checks the cross-level bubble to see that it is centered. If it is not, he centers it with the adjusting nut. During the traverse back to the aiming stake, he watches the cross-level bubble to keep it centered. He looks at the collimator from time to time to determine how much more traverse is needed. However, while traversing the mortar, he does not watch the collimator.

d. Whenever it is impossible to place the deflection on the mortar by the traversing handwheel (the limit of traverse is reached before the sight is on the aiming stake), the mortar is laid for deflection by moving the bipod legs. This is necessary because there are only 250 mils of traverse possible on the traversing mechanism. However, a deflection of 150 mils on either side of zero (a total of 300 mils) can be set on the sight. In these cases the gunner sets the sight with the announced deflection, centers the traversing bearing, and moves the bipod legs until the vertical line of the collimator is alined approximately on the left edge of the aiming stake. The gunner then makes the final small shift to the stake with the traversing handwheel and the adjusting nut. Whenever a new aiming stake is indicated in the fire command, the gunner lays the mortar by moving the bipod legs.

4-7. LAYING FOR ELEVATION AND DIRECTION

A standardized procedure for setting the sight and laying the mortar for elevation and direction is necessary to prepare the mortar for firing speedily and accurately. The procedure is as follows:

a. The mortar is mounted, and the Squad leader/gunner receives the following initial fire command: NUMBER ONE, HE, ONE ROUND, LEFT FOUR ZERO, BASE STAKE, EIGHT HUNDRED. The gunner repeats all elements of the fire command, He immediately sets the deflection left 40 on the deflection scale on the sight with his left hand, then looks up the elevation and charge for 800 meters on his firing table, announces CHARGE TWO, and sets 65.3° on the elevation scale.

b. Since the angles of deflection and elevation have been measured on the sight, the elevating crank and traversing handwheel are turned in the proper direction to lay the mortar correctly. Therefore, the gunner turns the elevating crank until the longitudinal level bubble is centered and rotates the adjusting nut until the cross-level bubble is centered. Note that the sight is set for deflection and then elevation, while the mortar is first laid for elevation and then deflection. He checks the vertical line of the collimator and simultaneously turns the adjusting nut and traversing handwheel in the same direction until the vertical line is laid on the left edge of the aiming stake. Again he checks the cross-level bubble and the longitudinal level bubble. When the gunner has accurately laid the mortar, he commands, FIRE.

c. When the gunner is required to move the bipod legs in laying the mortar for direction, he cannot lay the mortar accurately for elevation until after he has moved the bipod legs. In this case, he follows this sequence: sets the sight for deflection and then elevation, moves the bipod legs until the vertical line in the collimator is approximately on the aiming stake, and lays the mortar for elevation and then accurately for deflection.

4-8. LAYING FOR DIRECTION BY COMPASS DIRECTION METHOD.

a. As the mortar is normally located in defilade, it is laid by compass direction when the direct alinement method cannot be used.

b. The procedure for laying the mortar on a given direction follows:

(1) The gunner drives a stake in the ground to mark the position of the baseplate. Making sure that the mortar and other metallic equipment are at a distance of not less than 10 meters from the position, he rests his compass on the stake and rotates it until the direction is laid off on the mil scale. Sighting through the compass, he then directs ammo man to drive an aiming stake on this direction at a distance of about 25 meters.

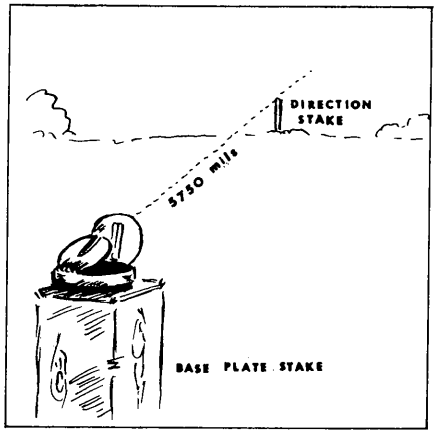


Fig 4-2. Placing the baseplate stake and direction stake.

(2) The mortar is mounted at the position of the baseplate stake. With the initial setting placed on the sight, the gunner shifts the bipod until the vertical line of the collimator is on the left edge of the aiming stake. He lays for elevation, cross-levels, and then lays for direction.

4-9. LAYING THE SECTION PARALLEL

a. The sheaf of fire of a section is the pattern that a round fired from each mortar at the same time makes on the ground. A parallel sheaf is desired for the section. In a parallel sheaf the distance between bursts is the same as the distance between mortars. The first requirement in obtaining a parallel sheaf is to initially lay all mortars parallel.

b. Initial direction for the base mortar is obtained by the compass direction method using a compass to aline the mortar on the desired direction.

c. The remaining mortars of the section are mounted parallel to the base mortar by laying them in the desired direction of fire using the same compass used to lay the base mortar.

d. The mortars are located on a 75-meter front, 35-40 meters between mortars. In a section firing position the mortars are numbered from the right to left, facing in the direction of fire, regardless of their regular squad numbers.

4-10. NIGHT LAYING

To fire the 60-mm mortar at night, use an M10 aiming post with an M14 aiming post light attached. When the aiming post light is turned on, a thin green vertical light filters through the lens. Set the sight and level the bubbles by the light from the hand light of the M37 instrument light. To lay the mortar, turn on the collimator light. This causes the white line of the collimator to become visible. Then lay the white line in the collimator on the thin green vertical line of the aiming post light.

4-11. CHECKING FOR MASK CLEARANCE AND OVERHEAD INTERFERENCE

a. The mortar is usually masked to the front because it is normally mounted in defilade. This mask may be a hill, trees, a building, or just a rise in the ground. In any case, the gunner must be sure that the round will clear the mask and will not strike it. Also, he must be sure that there is no overhead interference by overhanging branches of trees.

b. When selecting the exact mortar position, the gunner checks quickly by eye for mask clearance and overhead interference. After the mortar is mounted, the gunner makes a more thorough check.

c. When an elevation of 40° is set on the sight and the collimator is tilted to its extreme upward (rear) position, the line of sight through the open sight is 2^{o} below the axis of the bore. To determine whether it is safe to fire a round at any elevation, the procedure is as follows:

(1) The gunner sets his sight at the desired elevation and then lays the mortar at that elevation.

(2) He then sets the sight at an elevation of 40°, tilts the collimator to the extreme rear position, and looks through the open sight. If the line of sight through the open sight clears the mask, it is safe to fire; if it does not, it is unsafe to fire. The gunner may still fire at the desired range by selecting a charge zone that has a higher elevation for that particular range. When the line of sight does not clear the mask and no higher elevation is available, the mortar is moved to another position.

(3) The gunner makes a careful check to see that the rounds will not pass through the branches of trees. By placing the line of sight on the overhang interference, being sure to set the sight at 40 with the collimator tilted to the rear, the gunner levels the elevation bubble by turning the elevation knob on the sight and subtracts 4 from the reading on the elevation scale. This reading is the highest elevation safe to fire.

d. The gunner can usually determine mask clearance more quickly by sighting along the top of the barrel with his eye placed near the base cap. When it is not safe to fire, he so announces.

Section III. MANIPULATION

4-12. MANIPULATION FOR TRAVERSING FIRE

a. To distribute fire laterally across a target in width, traversing fire is used. Assume that fire has been adjusted on a target and that the mortar is laid with the firing data (deflection and elevation) for the last round fired in the adjustment; for example, deflection zero, base stake, elevation 71°.

b. The leader issues a subsequent fire command, for example:

FOUR ROUNDS
TRAVERSE RIGHT, THREE TURNS
SEVEN HUNDRED

c. The gunner repeats each element of the fire command. As deflection is not included in this fire command, he does not place any new deflection on the deflection scale. He looks up the elevation and charge, announces: CHARGE TWO, and sets the elevation scale at 69. 2°.

d. The gunner then checks the traversing mechanism to see whether there is enough space on the traversing tube to allow him to traverse right a total of 9 turns (the number of turns announced in the fire command times the number of intervals between rounds). If there is not, he prepares the mortar to traverse right by turning the traversing handwheel until the traversing bearing is positioned all the way to the right (barrel to the left). Then he turns the traversing handwheel two turns in the opposite direction to allow some latitude for the final adjustment on the aiming stake. He moves the bipod legs until the white line of the collimator is approximately laid on the left edge of the aiming stake. He then centers the bubble in the longitudinal level, cross-levels, and lays accurately with the traversing handwheel while keeping the mortar cross-leveled. When he is satisfied with the lay of the mortar, he commands: FIRE ONE.

e. He then executes the remainder of the operation as follows: After firing the first round, he traverses right 3 turns (turns the traversing handwheel three full turns in the direction necessary to cause the barrel to move to the right) keeping the mortar cross-leveled, and commands: FIRE TWO, for the second round. He traverses right 3 more turns, keeping the mortar cross-leveled, and commands: FIRE THREE, for the third round. He traverses right 3 more turns, keeping the mortar cross-leveled, and commands: FIRE FOUR, for the fourth round, and announces: ROUNDS COMPLETE.

4-13. MANIPULATION FOR SEARCHING FIRE

a. To distribute fire over a target in depth, searching fire is used. Assume that fire has been adjusted on a target and that the mortar is laid with the firing data for the last round fired in the adjustment; for example, deflection zero, base stake, elevation 68°.

b. The leader issues a subsequent fire command, for example:

FOUR ROUNDS
SEARCH EIGHT HUNDRED
SEVEN TWO FIVE

c. The gunner repeats each element of the fire command. As no deflection was included in this fire command, he does not place any new deflection on the deflection scale of the sight. He looks up the elevations and charge for 800 and 725 meters and finds them to be 65. 3°, charge 2, and 68. 3°, charge 2. He sets 65. 3° on the sight and computes the number of turns that he will have to elevate the mortar between rounds. In this case, the mortar is elevated two turns between each round. He also announces: CHARGE TWO, to the A/Gunner.

d. The gunner then lays the mortar for elevation by turning the elevating crank until the bubble in the longitudinal level is centered and checks the cross-level bubble to make sure that it is centered. When he is satisfied with the lay of the mortar, he commands: FIRE ONE. He then executes the remainder of the operation as follows: After firing the first round he searches up two turns (turns the elevating crank two full turns in the direction necessary to elevate the barrel), checks the cross-level bubble to see that it is centered, and commands: FIRE TWO,

for the second round. He searches up 2 more turns, checks to insure that the mortar is cross-leveled, and commands: FIRE THREE, for the third round. He again searches up 2 turns, checks to see that the mortar is still cross-leveled and commands: FIRE FOUR, for the fourth round, and announces, ROUNDS COMPLETE.

4-14. MARKING BASE DEFLECTION

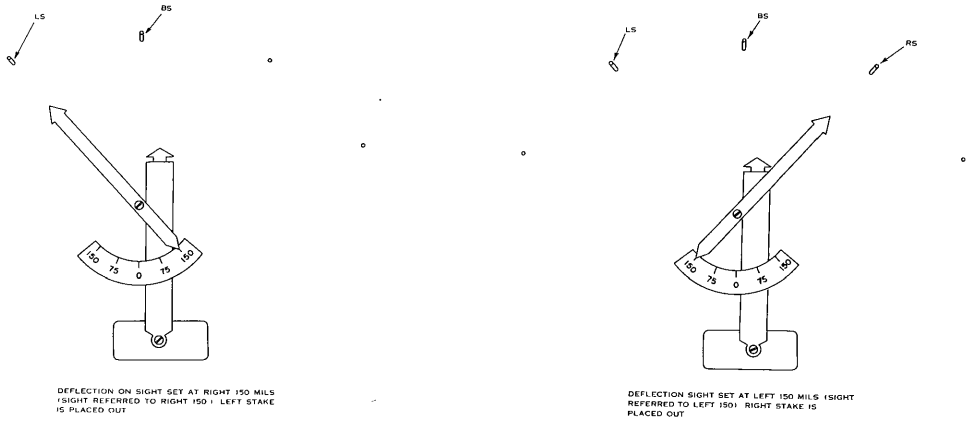
To help make rapid adjustments on new targets, an origin of shift is established as early as possible. This origin of shift is usually the first target engaged or any clearly defined point in the target area. It is called the base point, and the deflection of this point is called base deflection. Base deflection is marked on the ground as soon as adjustment is completed upon the base point (or in case the base point is the initial target, as soon as fire for effect on the target is completed) when the immediate engagement of another target is not anticipated. The mortar is usually mounted initially on a direction to the center of the sector of fire. As the base point is seldom exactly in the center of the sector of fire, the mortar following the adjustment on the base point will generally not be pointed in the direction on which it was initially laid. For example -- A base point was adjusted upon with a deflection of left 50, base stake. Base deflection is marked by realining the base stake in the direction of fire to the base point. The command to mark base deflection is: MARK BASE DEFLECTION. Upon receiving this command, the gunner checks to see that the mortar is laid with the correct data to hit the base point and then turns the deflection scale on the sight to zero, taking care not to disturb the lay of the mortar. This is known as referring the sight. Referring is the process of directing the line of sight to an aiming point without changing the lay of the mortar. The Assistant Gunner resets the base stake on which the mortar was first alined so that this stake is now alined with the vertical line of the collimator. The deflection of the base point is now zero. When base deflection is marked, the gunner centers the traversing bearing, moves the bipod, and re-lays on the stake. Space is now provided on the traversing mechanism for deflection corrections to the right or left when new targets are engaged.

4-15. PLACING OF ADDITIONAL AIMING STAKES

a. General. Since the maximum deflection that can be set on the sight is 150 mils to the right or left of zero, it becomes necessary to set out additional stakes. These are set at 150-mil intervals to the right and left of the base stake and make possible the laying of the mortar on targets located at more than 150 mils to the right and left of the base point. In the attack, at least two additional stakes are placed out immediately after marking base deflection. In a defensive position, at least four additional stakes are placed out. Whenever the situation permits, the stakes are placed approximately 25 meters from the mortar.

b. Procedure.

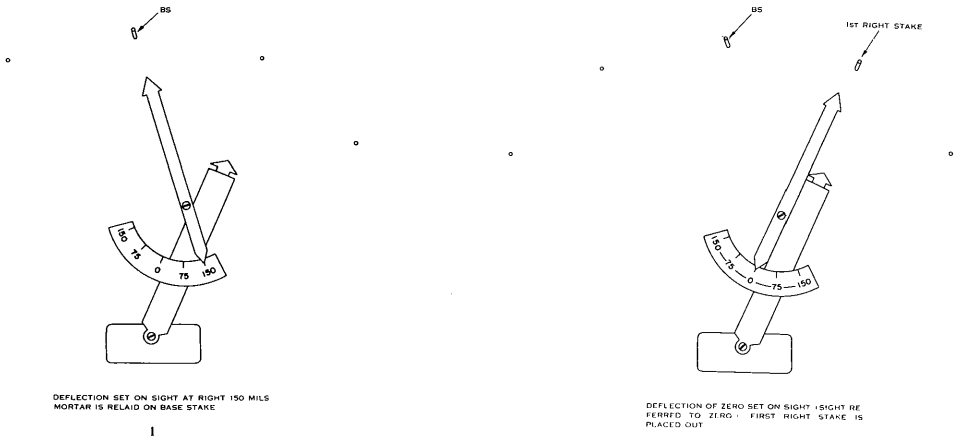
(1) For two stakes (fig 4-3). After marking base deflection and without moving the mortar, the gunner sets the deflection scale at right 150 mils and directs one of his ammunition men to drive the left stake so that the left edge of the stake is in alinement with the vertical line of the collimator. This stake is then 150 mils to the left of the base stake. The gunner then rotates the deflection knob until the scale registers left 150 mils and has the ammunition man drive the right stake. These stakes make it possible to engage targets 300 mils to the right and left of the base stake, because, with the deflection scale set at zero, a movement of the bipod to place the vertical line of the collimator on the right (or left) stake permits the mortar to be shifted an additional 150 mils to the right (or left). Therefore, with two additional stakes, a frontage of 600 mils can be covered. Example: To engage a new target which is 225 mils to the left of the base point, the fire command, so far as it concerns direction, is: LEFT SEVEN FIVE, LEFT STAKE.



A B

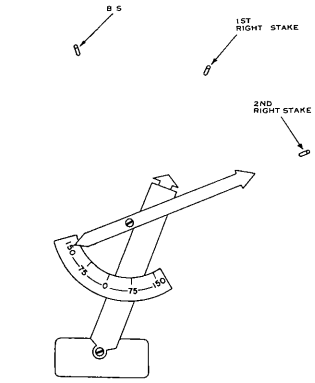
Fig 4-3. Placing out two additional aiming stakes.

(2) For four stakes (fig 4-4). Having marked base deflection, to place two additional stakes to the right, the gunner sets right 150 mils on the deflection scale (the vertical line of the collimator is then pointed to the left) (fig 4-4A). He then moves the bipod legs until the line of the collimator is placed approximately on the left edge of the base stake. He lays accurately by traversing and cross-leveling simultaneously. He rotates the deflection knob until the scale registers zero. Then, without moving the mortar, he directs an ammunition man to drive the first right stake so that its left edge is on line with the collimator (fig 4-4B). He once more rotates the deflection knob in the same direction until he sets left 150 mils on the scale. The ammunition man then drives the second stake (fig 4-4C). To place two additional stakes to the left of the base stake, the gunner with a sight setting of left 150 mils, moves the bipod legs until the line of the collimator is approximatley on the left edge of the base stake (fig 4-4D). He then repeats the process in the opposite direction. These stakes are designated as the first left stake and the second left stake. A frontage of 900 mils can be covered with four additional stakes.



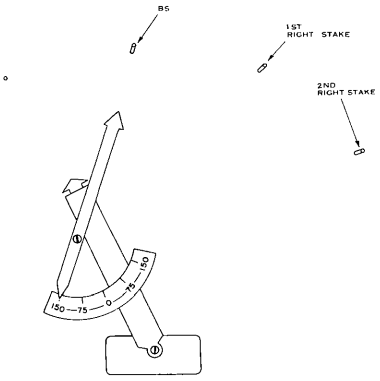
A B

Fig 4-4. Placing out four additional aiming stakes.



DEFLECTION OF LEFT 150 MILS SET ON SIGHT.
SECOND RIGHT STAKE PLACED OUT

C



WITH DEFLECTION OF LEFT 150 MILS SET ON SIGHT, MORTAR IS RELAID ON BASE STAKE BY MOVING BIPOD

D

Fig 4-4--contd

Chapter 5

CREW DRILL AND GUNNER'S EXAMINATION

Section I. CREW DRILL

5-1. INTRODUCTION

Crew drill consists of familiarizing each squad member in the duties of the other members of the squad in carrying the mortar and equipment, in placing the mortar in action, and in servicing the mortar during firing. The squad members are rotated through all squad positions to insure proficiency in the duties of each member of the mortar squad. Every member of the mortar squad must become proficient in the duties of the mortar gunner. The first objective in squad drill is the development of accuracy in mounting and laying the mortar. After this has been achieved, emphasis is then placed on speed.

5-2. DUTIES OF SQUAD MEMBERS

There are four enlisted Marines in the mortar squad. Their positions and duties are as follows:

a. (Squad leader/ gunner) supervises the emplacement, laying, and firing of the mortar. He also places firing data on the sight and lays the mortar for deflection and elevation, and makes safety checks.

b. (Assistant gunner) checks the barrel for cleanliness, assists the gunner in laying the mortar, and loads the mortar.

c. (Ammunition man) prepares the ammunition for firing and passes it to the assistant gunner. He also places the aiming stakes.

d. (Ammunition man) prepares ammunition for firing, and provides local security.

5-3. SQUAD COMMANDS

Squad commands are essential to squad members for use in squad drill. Squad commands may be oral (voice) or arm-and-hand signals. Arm-and-hand signals may be improvised at squad level. All of these commands should be brief and as simple as possible. The oral commands for use in controlling the mortar squad during squad drill are:

a. SECURE EQUIPMENT. At this command the squad members will obtain their normal mortar equipment and fall in formation at the place designated by the squad leader/gunner. In combat, where the squad may be in any one of several formations and the equipment may be on a vehicle or pack transport, the command is: OFF CARRIER.

b. GROUND EQUIPMENT. At this command all squad members place their respective mortar equipment on the ground immediately in front of them. At the original assembly and at all halts, the equipment is grounded without command.

c. CARRY EQUIPMENT. This command is given before starting any movement on foot. At this command the squad members pick up the mortar equipment and prepare to move out.

d. ACTION. At this command the mortar will be mounted and laid by the compass azimuth method.

e. SQUAD COLUMN. At this command the squad forms an irregular column behind the gunner. Squad drill will start and end from this formation.

f. FOLLOW ME. At this command the squad forms an irregular column behind the gunner and follows him.

g. FALL OUT GUNNER (or any member). At this command the man designated will ground his equipment (if being carried) and form in the last position in the mortar squad. All other squad members will move up one space. They will immediately count off. Each man receiving a new number will assume the equipment and duties corresponding to his new number. This rotation is made during crew drill to train each member of the squad in the duties of the other squad members.

EXAMPLE: The command is given FALL OUT GUNNER. The gunner will ground his equipment and move to the rear of the squad formation and assume the duties and equipment of the ammo man. The other members of the squad, the Nos. 2, 3, and 4 men will move up one space within the squad and secure the equipment corresponding to the new position. When the assistant gunner has completed his move he will sound off with his new number and each squad member behind him will count off from front to rear.

h. OUT OF ACTION. At this command the mortar will be dismounted, the individual squad members will recover their equipment and form as designated by the gunner.

5-4. SQUAD EQUIPMENT

a. The mortar squad is entrusted with a large amount of government property. This property is issued in two classes, individual equipment and squad equipment. Individual equipment is all the necessary items of supply to sustain one person in the field. Mortar squad equipment is all the necessary items of mortar equipment for employment of, and caring for, the mortar.

b. During the conduct of crew drill, each member of the mortar squad will carry, and is responsible for, the equipment that he will use in the execution of his assigned job. This equipment is carried in addition to individual equipment. In order to add realism to crew drill, each member of the mortar squad should wear a helmet and carry his T/O weapon. The mortar equipment normally carried by each member of the squad is listed below (fig 5-1):

(1) **Squad leader/ gunner**

Sight M4
Binocular
Compass (lensatic)
Ammunition bag M2A1 (6 rounds of ammunition)
Aiming post M10
Firing tables
Flashlight

(2) **Assistant gunner**

Mortar, complete
Firing tables

(3) **Ammunition man**

1 Ammunition bag, M2A1
(12 rounds of ammunition)
2 Aiming stakes
Cleaning staff

(4) **Ammunition man**

1 Ammunition bag, M2A1
(12 rounds of ammunition)
2 Aiming stakes

Fig 5-1. 60-mm mortar squad with load.

5-5. PLACING THE MORTAR IN ACTION

To prepare the mortar to fire on a target, the command is ACTION. All movements of the squad simulate, as much as possible, actions under combat conditions.

a. All members of the squad, except the gunner, ground their loads.

b. The gunner indicates the approximate position of the mortar by placing the sight case on the ground. He then gives the direction of fire by placing the direction stake (direction by the direct alinement method) or by announcing the magnetic direction (direction by the compass direction method).

c. When the first method is used, the asst/gunner drives a stake at the position indicated by the sight case and as alined by the gunner. When the second method is used, the assistant gunner receives the compass from the gunner and drives a baseplate stake at the indicated location. The assistant gunner, using the compass, then directs the ammunition man in placing an aiming stake to establish the direction of fire.

d. As soon as the direction of fire is established, the mortar is mounted with the left front corner of the baseplate against the baseplate stake and with the left edge of the baseplate alined on the direction stake.

e. The squad members then take their position as follows (fig 5-2).

(1) Gunner sits on the left side of the mortar in a position convenient to the elevating and traversing mechanisms.

(2) Assistant gunner takes a prone position on the right side of the mortar in a position from which he can load.

(3) Both ammunition men are echeloned to the right and left rear where they can supply ammunition to the assistant gunner and provide local security.

Fig 5-2. Disposition of the 60-mm mortar squad in action.

Section II. GUNNER'S EXAMINATION

5-6. INTRODUCTION

The gunner's examination is a continuation of crew drill and should be the final step in training the Marine before live fire is attempted. The gunner's examination stresses speed as well as accuracy and includes situations that the gunner will be called upon to perform in a combat situation. The entire gunner's examination should be fully explained to each member of the squad. Instructions in mechanical training, portions of crew drill, fire commands and their execution should be fully covered when instructing the section. At the start, extreme accuracy should be stressed; speed will come with practice. The gunner's examination will help build competition within the mortar squad and section. It will show the mortar leader areas in which each member is deficient. Each gunner being tested will perform all elevating, cross-leveling, traversing and laying of the mortar with authorized aid only.

5-7. SUPERVISORY PERSONNEL

The weapons platoon commander and platoon sergeant will normally administer the gunner's examination. The weapons platoon commander will be the final authority when questions arise during the examination.

5-8. EXAMINATION SUBJECTS

Maximum points for test:	Value
Mounting the mortar	40
Laying the mortar with initial fire data	30
Re-laying the mortar for changes in fire data	30
Marking base deflection	30
Laying mortar on additional aiming stake	30
Manipulation of the mortar for traversing fire	40
Total possible points	200

5-9. QUALIFICATION SCORES

Qualification	Scores
Expert gunner	180-200
First class gunner	160-179
Second class gunner	140-159
Unqualified	0-139

5-10. GENERAL RULES GOVERNING EXAMINATION

The following rules govern the examination:

a. The conditions of the examination are made as nearly uniform as possible for all candidates. The officer in charge is responsible for safeguarding information contained in examinations. He makes sure that a candidate who takes a test does not pass on data contained in the test to another candidate; he also makes sure that no candidate receives the benefit of a sight setting or a mortar laid by another candidate.

b. The officer does not give ranges to the candidate that will require him to make more than 10 turns of the elevating crank. As the mortar is laid initially with an elevation of 62^{o} in each of the steps in which a range is given, only ranges with elevation of 57^{o} to 67^{o} inclusive may be given.

c. Should any candidate fail in any trial through the fault of an examiner or an assistant, or because of the failure or malfunction of the sight or other instrument used, that trial is disregarded and the candidate is given another trial.

d. The candidate selects the assistants he is authorized.

e. Each candidate is given the tests in the order in which they are described in paragraphs 5-12 through 5-17.

f. In any test requiring the candidate to lay for elevation or to cross-level the mortar, the officer considers the position of the bubble in either the longitudinal or cross-level vial to be correct if the bubble is inside or tangent to the outside etched lines on the glass tube.

g. When, because of excess play, a mortar has failed to maintain the lay after the candidate has called UP or FIRE, the officer twists the mortar (taking up the play without manipulation) until the vertical line of the collimator is again alined on the stake. If the cross-level bubble is correct at this point, the candidate is given full credit for that trial, provided the other conditions are correctly fulfilled.

h. The officer makes sure that no unauthorized assistance is given the gunner during the examination. The gunner has been trained for combat performance of his duties and is tested with this thought in mind.

5-11. QUALIFICATION COURSE

The following paragraphs give the requirements of the qualification course (Gunner's Examination). The test is divided into six steps. Each step is run and scored twice. For a sample of the qualification score card, see figure 5-3.

5-12. STEP I-MOUNTING THE MORTAR

a. Equipment.

(1) For candidate. Complete mortar with sight and two aiming stakes.

(2) For testing officer. Stop watch and score card.

b. Conditions.

(1) Two stakes are driven about 25 meters apart; one designates the mortar position and the other indicates the direction of fire.

(2) The mortar is laid out on the ground at the position where it is to be mounted (indicated by a stake). The baseplate is attached to the spherical projection and the legs are strapped to the barrel. The sight, in a latched case, is placed near the mortar. The candidate takes up a kneeling position to the left of and on line with the mortar.

GUNNER'S EXAMINATION

60-mm MORTAR

NAME L/Cpl. Hall, R.S.

DATE 4 Aug 67 UNIT A Co. 1-5

		TIME	POINTS	SCORE
MOUNTING	1	58	16	36
MORTAR	2	48	20	
LAYING WITH	1	23	15	30
INITIAL DATA	2	22	15	
RE-LAYING FOR CHANGES IN FIRING DATA	1	24	0	15
	2	23	15	
MARKING BASE DEFLECTION	1	45	15	30
	2	50	15	
LAYING ON	1	40	11	26
ADDITIONAL STAKE	2	34	15	
MANIPULATION FOR TRAVERSING FIRE	1	45	20	40
	2	43	20	
TOTAL SCORE				177
QUALIFICATION				1st Class Gunner

VERIFIED Lt. Charles J. Davis

Fig 5-3. Suggested scorecard for gunner's examination.

(3) Each candidate is given two trials, both are scored.

c. Procedure.

(1) The candidate executes the premounting check to see that:

(a) There is one finger clearance on the unpainted surface of the left leg below the adjusting nut.

(b) The locking nut is not tight (or too loose).

(c) The traversing bearing is centered.

(d) The binding strap is not entangled.

(2) When the candidate is ready to mount the mortar, the examiner gives the command for mounting the mortar. For example, TO YOUR FRONT, ACTION.

(3) At this command, the mortar is mounted, with the sight attached, and laid on the left edge of the aiming stake.

(4) As soon as the mortar is mounted and laid, the candidate calls, UP.

(5) Time is taken from the command ACTION to the announcement UP by the candidate.

d. Scoring.

(1) No credit is given if the:

(a) Time exceeds 75 seconds.

(b) Sight is not set correctly for deflection (zero) and elevation (62^{o}).

(c) Mortar is not correctly laid for elevation (longitudinal level bubble not centered).

(d) Mortar is not cross-leveled (cross-level bubble not centered).

(e) Vertical line of the collimator is more than 5 mils off the left edge of the aiming stake.

(f) Traversing mechanism (bearing) is more than two turns to the left or right of the center position.

(2) When the mortar is found to be correctly laid within the limits prescribed, credit is given as follows:

Time in seconds	50 or less	51-55	56-60	61-65	66-70	71-75
Credits	20	18	16	14	12	10
Total possible score (two trials)						40

5-13. STEP II-LAYING THE MORTAR WITH INITIAL FIRE DATA

a. Equipment.

(1) For candidate. Complete mortar with sight, one aiming stake, and firing table.

(2) For testing officer. Stop watch and score card.

b. Conditions.

(1) The mortar is mounted with a base stake placed approximately 25 meters from the mortar position. The mortar is laid on the stake with the sight set at zero deflection and the traversing mechanism (bearing) approximately centered. The elevation scale is set at 62^{o} and the longitudinal and cross-level bubbles are centered.

(2) For each trial, the candidate takes the gunner's position on the left of the mortar and checks to see that it is mounted correctly and laid as described. If the candidate desires, he may start this test with his left hand on the deflection knob of the sight.

(3) The amount of deflection given does not exceed 60 mils and the range given does not require an elevation less than 57^{o} or greater than 67^{o}.

(4) Each candidate is given two trials, both are scored.

c. Procedure.

(1) When the candidate is ready to receive the command, an initial fire command is announced by the testing officer. For example: NUMBER ONE, HE, ONE ROUND, RIGHT FIVE ZERO, BASE STAKE, EIGHT HUNDRED.

(2) The candidate repeats each element of the fire command, sets the sight with the given deflection, looks up the elevation and charge for 800 meters, announces the correct charge, lays the mortar for elevation, and re-lays on the left edge of the aiming stake, cross-leveling simultaneously. As soon as the mortar is laid the candidate commands: FIRE.

(3) Time is taken from RANGE in the fire command to the command FIRE by the candidate.

d. Scoring.

(1) No credit is given if the-

(a) Time exceeds 40 seconds.

(b) Sight is set incorrectly for elevation or deflection.

(c) Mortar is not correctly laid for elevation.

(d) Mortar is not cross-leveled.

(e) Vertical line of the collimator is more than 5 mils off the left edge of the aiming stake.

(2) When the mortar is found to be laid correctly within the limits prescribed, credit is given as follows:

Time in seconds	25 or less	26-28	29-31	32-34	35-37	38-40
Credits	15	13	11	9	7	5
Total possible score (two trials)						30

5-14. STEP III-RE-LAYING THE MORTAR FOR CHANGES IN FIRING DATA

a. Equipment.

(1) For candidate. Complete mortar with sight, one aiming stake, and firing table.

(2) For testing officer. Stop watch and score card.

b. Conditions.

(1) The mortar is mounted with a base stake placed approximately 25 meters from the mortar position. The mortar is laid on the stake with a deflection of less than 75 mils set off on the sight and the traversing mechanism (bearing) approximately centered. The elevation scale is set at 62^{o} and the longitudinal and cross-level bubbles are centered.

(2) For each trial, the candidate takes the gunner's position on the left of the mortar and checks to see that it is mounted correctly and laid as described. If the candidate desires, he may start this test with his left hand on the deflection knob of the sight.

(3) The amount of deflection given does not exceed 60 mils and the range given does not require an elevation less than 57^{o} or greater than 67^{o}.

(4) Each candidate is given two trials, both are scored.

c. Procedure.

(1) When the candidate is ready to receive the command, a subsequent command is announced by the testing officer. For example: LEFT FOUR ZERO, EIGHT HUNDRED.

(2) The candidate repeats each element of the fire command, sets the sight with the correct deflection (announced deflection added algebraically to the previous deflection setting), looks up the elevation and charges for 800 meters, announces the correct charge, lays the mortar for elevation, and re-lays on the left edge of the aiming stake, cross-leveling simultaneously. As soon as the mortar is laid, the candidate commands: FIRE.

(3) Time is taken from RANGE in the fire command to the command FIRE by the candidate.

d. Scoring.

(1) No credit is given if the -

(a) Time exceeds 40 seconds.

(b) Announced charge is incorrect or omitted.

(c) Sight is set incorrectly for elevation or deflection.

(d) Mortar is not correctly laid for elevation.

(e) Mortar is not cross-leveled.

(f) Vertical line of the collimator is more than 5 mils off the left edge of the aiming stake.

(2) When the mortar is found to be laid correctly within the limits prescribed, credit is given as follows:

Time in seconds	25 or less	26-28	29-31	32-34	35-37	38-40
Credits	15	13	11	9	7	5
Total possible score (two trials)						30

5-15. STEP IV-MARKING BASE DEFLECTION

a. Equipment.

(1) For candidate. Complete mortar with sight, and three aiming stakes.

(2) For testing officer. Stop watch and score card.

b. Conditions.

(1) The mortar is mounted with the base stake placed approximately 25 meters from the mortar position. A deflection (not less than 40 mils or more than 60 mils) is set off on the sight and the mortar is re-laid on the base stake by traversing. The elevation scale is set at 62° and the longitudinal and cross-level bubbles are centered. The conditions set forth are checked by the candidate before his first trial.

(2) The candidate is allowed one assistant to place out aiming stakes.

(3) Each candidate is given two trials, both are scored.

c. Procedure.

(1) When the candidate is ready, the examiner issues the following command: MARK BASE DEFLECTION, PLACE OUT TWO ADDITIONAL AIMING STAKES.

(2) The candidate repeats the command, sets the sight with a deflection of zero, and without changing the lay of the mortar directs his assistant in realining the base stake. The assistant cannot move out from the vicinity of the mortar until the announcement of the first element of the command. He realines the base stake by moving it in line with the white line of the collimator as directed by the candidate. The candidate then centers the traversing bearing and relays the mortar on the base stake with zero mils deflection by moving the bipod legs. As soon as the mortar is relaid on the base stake, the candidate places left and right 150 mils on the sight and directs the assistant in placing out the first right and left stakes. He then resets the deflection scale at zero and announces UP.

(3) Time is taken from the first word, MARK, of the command to the announcement UP by the candidate.

d. Scoring.

(1) No credit is given if-

(a) Time exceeds 75 seconds.

(b) Traversing handwheel is turned before the base stake is realined.

(c) Sight is set incorrectly for deflection.

(d) Mortar is not cross-leveled.

(e) Angle between the base stake and the additional aiming stakes is in error more than 5 mils.

(f) Vertical line of the collimator is more than 5 mils off the left edge of the aiming stake.

(g) The traversing bearing is more than two turns off center.

(2) When the mortar is found to be laid correctly within the limits prescribed, credit is given as follows:

Time in seconds	60 or less	61-63	64-66	67-69	70-72	73-75
Credits	15	13	11	9	7	5

Total possible score (two trials) . . . . . 30 points.

5-16. STEP V-LAYING MORTAR ON ADDITIONAL AIMING STAKE

a. Equipment.

(1) For candidate. Complete mortar with sight, three aiming stakes, and firing table.

(2) For testing officer. Stop watch and score cards.

b. Conditions.

(1) Three aiming stakes are set out approximately 25 meters from the mortar in such position that the angular distance between the center stake and each of the flank stakes measured at the mortar position is 150 mils. The stakes are designated as base stake, first left stake, and first right stake.

(2) The mortar is mounted with the elevation scale set at 62^{o}, and the longitudinal and cross-level bubbles are centered. The deflection scale is set at zero and the traversing mechanism (bearing) is approximately centered. The mortar is laid initially on the base stake and checked by the candidate before each trial is begun.

(3) The amount of deflection given does not exceed 60 mils and the range given does not require an elevation less than 57^{o} or greater than 67^{o}.

(4) Each candidate is given two trials, both are scored.

c. Procedure.

(1) The candidate in the gunner's position on the left of the mortar may place his left hand on the deflection knob of the sight if he so desires. The testing officer gives the fire command for laying the mortar on either of the other two stakes. For example: NUMBER ONE, HE, ONE ROUND, LEFT TWO FIVE, FIRST RIGHT STAKE, SEVEN FIVE ZERO.

(2) The candidate repeats each element of the fire command, sets the sight with the given deflection, looks up the elevation and charge for 750 meters, announces the correct charge, sets the sight with the elevation, moves the bipod legs, lays the mortar for elevation, and re-lays on the left edge of the designated aiming stake with the announced deflection and with the elevation corresponding to the announced range. As soon as the mortar is laid, the candidate commands: FIRE.

(3) Time is taken from the announcement of the range in the fire command, to the command FIRE by the candidate.

(4) For the second trial, the mortar is relaid on the base stake. A different deflection, range, and aiming stake are given.

d. Scoring.

(1) No credit is given if the-

(a) Time exceeds 50 seconds.

(b) Sight is set incorrectly for elevation or deflection.

(c) Announced charge is incorrect or omitted.

(d) Mortar is not correctly laid for elevation.

(e) Mortar is not cross-leveled.

(f) Vertical line of the collimator is more than 5 mils off the left edge of the proper aiming stake.

(g) Traversing mechanism (bearing) is more than two turns off the center position.

(2) When the mortar is found to be laid correctly within the limits prescribed, credit is given as follows:

Time in seconds	35 or less	36-38	39-41	42-44	45-47	48-50
Credits	15	13	11	9	7	5

Total possible score (two trials) . . . . . 30 points.

5-17. STEP VI-MANIPULATION OF THE MORTAR FOR TRAVERSING FIRE

a. Equipment.

(1) For candidate. Complete mortar with sight, onc aiming stake, and firing table.

(2) For testing officer. Stop watch and score card.

b. Conditions.

(1) The mortar is mounted with a base stake set out approximately 25 meters from the mortar. The mortar is laid on the stake with the deflection scale set at zero and the traversing bearing approximately centered. The elevation scale is set at 62^{o} and the longitudinal and cross-level bubbles are centered.

(2) When the mortar has been laid, the testing officer directs the gunner to PREPARE TO TRAVERSE RIGHT (LEFT). The candidate then moves the traversing mechanism so that the bearing is positioned all the way to the right (or left). He then traverses back two turns to allow for laying the mortar exactly on the aiming stake. He does not relay on the aiming stake until the fire command is issued.

(3) The number of rounds specified in the fire command is always four.

(4) The amount of traverse between rounds fired is either two or three turns.

(5) The range given does not require an elevation of less than 57^{o} or greater than 67^{o}.

(6) Each candidate is given two trials, both are scored.

c. Procedure.

(1) When the candidate is ready, a fire command is announced by the testing officer. For example: FOUR ROUNDS, TRAVERSE RIGHT THREE TURNS, NINE HUNDRED.

(2) The candidate repeats each element of the fire command, looks up the elevation and charge for the announced range, announces the correct charge, sets the elevation on the sight, checks the deflection scale on the sight to make sure it is set at zero, moves the bipod legs, lays the mortar for elevation, re-lays on the left edge of the aiming stake, commands FIRE ONE; traverses the required number of turns, cross-leveling at the same time, commands FIRE TWO; traverses and cross-levels, commands FIRE THREE; traverses and cross-levels, and commands FIRE FOUR.

(3) Time is taken from RANGE in the fire command to the command FIRE FOUR by the candidate.

d. Scoring.

(1) No credit is given if the--

(a) Time exceeds 80 seconds.

(b) Announced charge is incorrect or omitted.

(c) Candidate fails to command FIRE for each round.

(d) Sight is set incorrectly for elevation.

(e) Candidate makes no attempt to cross-level before firing each round.

(f) Mortar is not cross-leveled after firing the last round.

(g) Vertical line of the collimator is more than 20 mils off the left edge of the aiming stake after the mortar has been traversed and cross-leveled in the opposite direction (by the testing officer) the total number of turns required by the fire command. The total number of turns is equal to the number of rounds fired less one, times the number of turns between rounds as specified in the fire command. For example: In the above sample fire command issued by the testing officer, the candidate is required to traverse right a total of nine turns. To check the manipulation, the mortar is traversed nine turns to the left, cross-leveled, and checked to see that the vertical line of the collimator is within 20 mils (right or left) of the left edge of the aiming stake.

(2) When the mission has been fired correctly within the limits prescribed, credit is given as follows:

Error in mils	10 or less	11-20
Credits:		
Time in 50 seconds or less	20	16
Time between 51 and 65 seconds	16	12
Time between 66 and 80 seconds	12	8
Total possible score (two trials)		40

Chapter 6

TECHNIQUE OF MORTAR FIRE

Section I. INTRODUCTION TO MORTAR FIRE

6-1. GENERAL

Technique of fire is the act of identifying targets and bringing fire to bear on them. This fire, in order to be effective, must destroy or neutralize the target. The forward observer (FO) will identify targets and send this information to the gun(s). The squad leader/gunner will process the information into fire data and place it on the gun. If the section is to fire, the section leader will process the information. The mortar crewmen must become expert in receiving fire commands and applying this information to the mortar. Often a few seconds delay in receiving mortar fire on a target can mean life or death, victory or defeat, to a rifle platoon.

6-2. COMMUNICATION

Communication between the observer and the mortar squad is by radio, wire, arm-and-hand signals, or messenger.

a. Radio. The radio used, when needed, by this section is the AN/PRC-25/77 (fig 6-1). These are located in the company. The range is about 3 miles. This is the primary means of communication between the observer and the guns in an offensive situation. Loss of radio communication is usually the result of poor maintenance and operation rather than equipment failure.

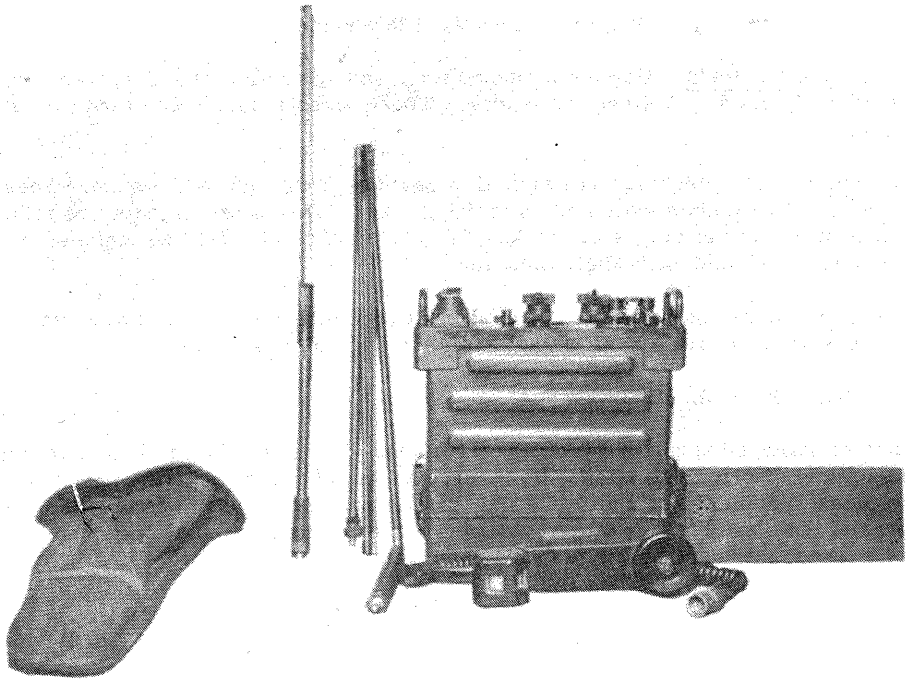


Fig 6-1. Radio set AN/PRC-25/77.

b. Wire. Wire is the primary means of communication between the observer and the guns in a defensive situation. Wire should be installed whenever the situation and time permit. Wire provides some inherent security that the radio does not have. It is not restricted to any set of rules of procedure, although the short-phrase, repeat-back method of communication is used. When adjusting fire by wire, it is not necessary to employ prowords. The standard sound-powered telephone used with the 60-mm mortars is the TA-1/PT telephone (fig 6-2).

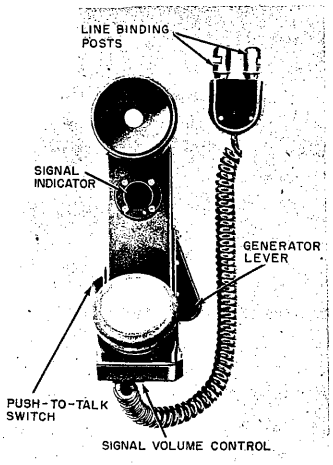


Fig 6-2. TA-1/PT telephone.

c. Arm-and-hand signals. Use the standard arm-and-hand signals. Other arm-and-hand signals may be designated by the section leader. These signals should be standard within the mortar section.

d. Pyrotechnics. Pyrotechnics are signaling devices using light and smoke. These devices are containers filled with chemicals and an igniting fuze. When these signals are ignited, they produce light or a variety of colors of smoke. If pyrotechnics are used as signals, every Marine in the section should know their meaning.

e. Messenger. Messengers can be used whenever all other means of communication fail. In most instances messengers are slow and should be used as a last resort.

6-3. DEFINITION OF COMMON TERMS

The use of standard terms between observers and the guns helps mutual understanding and reduces the volume of communication. However, the use of standard terms is not intended to restrict the transmission of any additional information that would assist in placing fire on a target. Some of the old terms have been changed. The terms shown below replace some of the old terms previously used by the forward observer.

New	Old
DIRECTION	AZIMUTH
FINAL PROTECTIVE FIRE (FPF)	BARRAGE
CHECK FIRING	CEASE FIRING
GRID	COORDINATES
TARGET	CONCENTRATION
SPOTTING	SENSING
ADJUST FIRE	WILL ADJUST

a. Registration point. A point in the target area whose location is known on the ground, on a firing chart, or on both. It must be easily identified and should be in the approximate center of the target area. It is used as a basis for computing data and as a point of origin for transferring or shifting fire.

b. Target.

(1) Enemy positions, material, or terrain that warrants engagement by fire and may be numbered for future reference.

(2) An observation indicating that the round hit the target.

c. Correction.

(1) A term used in a fire request to indicate that an error in data has been announced and that corrected data will follow.

(2) Any change in firing data to bring the center of impact closer to the target (such as a subsequent correction in a fire request).

d. Deviation. The distance, right or left as measured by the observer, by which a point of impact or burst misses the target. Deviation is normally measured by the observer in mils and converted into meters for the correction.

e. Registration. Adjusted fire delivered to locate a point so that firing data for later targets may be computed with reference to this point.

f. Final protective fire (FPF). A large volume of fire placed in an area rather than aimed specifically at a given target.

g. Reference point. Prominent, easily located point in the terrain.

6-4. ANNOUNCEMENT OF NUMBERS

When numbers are given as part of a message or command, whether by voice, telephone, or radio, exact hundreds and thousands are so announced; in other numbers, each digit is given separately. The decimal point is stated as POINT.

Examples:

Numbers	Announce as
50	FIVE ZERO
75	SEVEN FIVE
675	SIX SEVEN FIVE
700	SEVEN HUNDRED
1000	ONE THOUSAND
2400	TWO FOUR HUNDRED
5.5	FIVE POINT FIVE

Section II. FIRE COMMANDS

6-5. INTRODUCTION

a. Fire commands come from the observer. These commands contain the necessary data for the gunner to lay the mortar for elevation and direction, and to fire.

b. A correct fire command is brief, clear, and includes all the elements necessary for accomplishing the fire mission. Fire commands are announced to the firing mortar(s) as rapidly as each element of the command is determined. Whenever practicable, give fire commands orally. When oral commands are not practicable, use telephone, radio, or arm-and-hand signals. The gunner repeats all elements of the fire commands.

c. Fire commands are of two types: initial fire commands and subsequent fire commands. Both types of commands follow a definite sequence. Subsequent commands, however, include only such elements as are changed, except that the range or elevation is always given.

6-6. INITIAL FIRE COMMANDS

a. Sequence.

(1) Initial fire commands contain the data to lay the mortar and fire the first round. The sequence for transmission of fire commands is:

Mortars to follow commands
Type of ammunition
Mortars to fire
Method of fire (and restrictions)
Deflection
Range (elevation and charge)

(2) All fire commands follow this sequence.

b. Elements.

(1) The mortars to follow commands element serves two purposes; it alerts the mortar crews and it designates the mortars which are to follow commands. When the three mortars are operating as a unit, the command SECTION means that all mortars are to follow commands. If the fire of only one mortar is desired, the number of that mortar is substituted for SECTION and only that designated mortar crew follows the commands.

(2) The type of ammunition to be used is specified in the fire command as HE, WP, or ILLUMINATION.

(3) The mortars to fire element designates the specific mortar or mortars which are to fire. The command to fire all mortars is SECTION. The command to fire a single mortar in a section firing position is : NUMBER ONE (TWO). A squad leader leaves this element up to his squad.

(4) The method-of-fire element designates the number of rounds and the manipulation to cover the target. Typical commands are: ONE ROUND; THREE ROUNDS; TRAVERSE RIGHT (LEFT) THREE TURNS; SEARCH EIGHT HUNDRED—SEVEN TWO FIVE; and RIGHT (LEFT) ONE ROUND. In section fire to execute volley fire, each mortar fires the specified number of rounds regardless of the other mortars and as fast as accuracy permits. In section fire to execute RIGHT (LEFT) ONE ROUND, the mortars fire successively from right to left (left to right) at a designated time interval. For example, RIGHT AT FIVE SECOND INTERVALS. If no time is designated it is understood that the interval between rounds will be 5 seconds.

(5) The deflection element gives the deflection and the aiming point. It is announced as ZERO (RIGHT, LEFT-----), BASE (FIRST RIGHT, FIRST LEFT) STAKE, depending on the relation between the aiming point and the MT line. The announced deflection is the exact total deflection to be placed on the sight. Although the aiming point may be any point that the gunner can lay his sight on, it is usually an aiming stake. The aiming point may be given as BASE STAKE or as a numbered stake on the right or left of the base stake. For example, FIRST RIGHT STAKE, or SECOND LEFT STAKE. The deflection always precedes the aiming point. The nearest stake is given as the aiming point in all initial fire commands, using 75 as the dividing line. When the direction is exactly halfway between two aiming stakes (75 mils from both), the base stake or the stake nearest to the base stake is used as the aiming point. It is desirable (but not always possible) to use the same aiming stake throughout an adjustment. For example, for a target which is determined as 70 mils left of the base stake, the direction sent to the gunner is LEFT SEVEN ZERO, BASE STAKE. For a target which is determined as 100 mils to the right of the base stake, the direction sent to the gunner is LEFT FIVE ZERO, FIRST RIGHT STAKE. For a target which is determined as 230 mils to the left of the base stake, the direction sent to the gunner is RIGHT SEVEN ZERO, SECOND LEFT STAKE. The word "deflection" always precedes this command.

(6) The range is usually given in meters. For example: NINE FIVE ZERO. If the observer has a firing table, he may give the elevation and charge. This is the control element of every fire command, unless special instructions or restrictions have been given previously in the method of fire element.

6-7. EXAMPLES OF INITIAL FIRE COMMANDS

a. For a single mortar:

Mortars to follow commands:	NUMBER ONE
Type of ammunition:	HE
Mortars to fire:	
Method of fire:	ONE ROUND
Deflection:	ZERO, BASE STAKE
Range:	EIGHT HUNDRED

b. For a section:

Mortars to follow commands:	SECTION
Type of ammunition:	HE
Mortars to fire:	NUMBER TWO
Method of fire:	ONE ROUND, AT MY COMMAND
Deflection:	LEFT FOUR ZERO, FIRST RIGHT STAKE
Range:	SEVEN FIVE ZERO

6-8. SUBSEQUENT FIRE COMMANDS

Subsequent fire commands include only elements that are changed, except that the range is always announced. When a change is made in the mortars to fire or in the method of fire, include both elements in the subsequent command.

a. Corrections in deflection. Give corrections in deflection in mils as: RIGHT ONE ZERO; LEFT TWO FIVE. When the deflection is correct, this element is omitted in the subsequent fire command. The gunner must apply the deflection correction algebraically to the previous deflection setting on the sight. For example: The gunner has a deflection on his sight of RIGHT FIVE ZERO and receives a deflection correction of LEFT THREE ZERO. His new sight setting should be RIGHT TWO ZERO.

b. Correction in range. Always include this element in the subsequent fire command. For example: SIX FIVE ZERO. If the range does not change, repeat the command, SIX FIVE ZERO.

c. Check firing and suspend firing.

(1) CHECK FIRING is announced when an emergency condition arises and it is imperative that firing be discontinued immediately. Check fire may be announced by anyone who discovers such a condition. Firing may be resumed as soon as the emergency condition has been eliminated.

d. Termination of alert. The end of the alert is announced as: END OF MISSION. This allows the mortar crew to relax between fire missions so that they can respond to subsequent alerts more completely. The gunner automatically lays on the base stake with a deflection of zero and an elevation of 62° or, in a defensive situation, with the elevation and deflection for the final protective fire.

6-9. EXAMPLES OF SUBSEQUENT FIRE COMMANDS

a. For a single mortar:

Method of fire:	*FOUR ROUNDS
Deflection:	*RIGHT TWO ZERO
Range:	SEVEN FIVE ZERO

b. For a section:

Mortars to fire:	*SECTION
Method of fire:	*FOUR ROUNDS AT MY COMMAND
Deflection:	*LEFT ONE ZERO
Range:	EIGHT HUNDRED

* Given only when a change is made from a prior command.

6-10. REPEATING AND CORRECTING COMMANDS

a. Repeating commands. When the gunner fails to understand any element of the fire command, he requests a repeat of that element by announcing "Deflection was (elevation)." When any crew member asks that any element be repeated, avoid a misunderstanding by prefacing the repeated element with the phrase THE COMMAND WAS.

b. Corrections. In all initial fire commands, correct an incorrect element by announcing: CORRECTION, and giving the correct element. For example, to correct an erroneous range of SIX HUNDRED to a correct range of SEVEN HUNDRED, announce the following command: CORRECTION, SEVEN HUNDRED. When an erroneous element is given in a subsequent fire command, the procedure is as follows: announce CORRECTION and then give the entire command.

Section III. FIRING THE MORTAR

6-11. PROCEDURES BEFORE AND DURING FIRING

a. Safety checks before firing:

(1) The gunner makes certain that:

(a) There is mask and overhead clearance.

(b) The mortar is locked to the baseplate.

(c) The mortar clamp bolt is secure.

(d) The locking nut is tight.

(e) The legs are fully spread and locked in that position by the spring latch.

(f) The bubbles are leveled.

(2) The assistant gunner checks to see that the bore is clean and dry.

(3) The ammunition man checks to see that:

(a) Each round is clean-particularly the bourrelet.

(b) The safety pin and striker spring of each round are present.

(c) Increments are present and in proper condition.

b. To fire the mortar. After receiving an initial fire command the:

(1) Gunner sitting on the left side of the mortar in a position convenient to the elevating and traversing mechanisms (fig 6-3):

(a) Repeats the fire command.

(b) Sets the deflection on the sight.

(c) Looks up the elevation and charge and announces the correct charge to the assistant gunner.

(d) Sets the elevation on the sight.

(e) Lays for elevation.

(f) Lays for direction and cross-levels simultaneously.

(g) Removes the sight before firing the first three rounds, or until the baseplate is firmly seated.

(h) Checks the firing selector to see that it is set on DROP FIRE.

Fig 6-3. Gunner's position at mortar.

(i) Places his left hand on the left leg of the bipod and his right hand around the base cap to steady the mount and assist the seating of the baseplate during the firing of the first three rounds.

(j) Commands: FIRE.

(2) The assistant gunner

(a) Repeats command designating charge.

(b) Secures an unpacked round and checks for the presence of the safety pin. If it is not present, the round is not fired.

(c) Holds the round in the vertical position with the fuze end up. Withdraws the safety wire and tests the tension of the safety pin spring by pressing and releasing the safety pin with his thumb. If the safety pin becomes unseated, the round is armed. Such rounds are placed in a safe location to be destroyed by ordnance personnel.

Caution: Do not fire armed rounds because they may detonate in the mortar barrel. Armed rounds must be handled with care because they might be detonated by pressure on the striker.

(d) Tests for pressure of the fuze striker spring by pressing the striker head with the thumb of his left hand.

(e) Removes the necessary number of powder increments to leave the announced charge in place.

(f) Places his right hand on the right leg of the bipod to steady the mount during the firing of the first three rounds.

(g) At the gunner's command FIRE, he grasps the round with his left hand around the bourrelet and inserts the shell, fuze end up, in the muzzle of the mortar (fig 6-4). Upon releasing the shell, he immediately withdraws his hand to the rear.

Fig 6-4. Assistant gunner inserts a round.

(3) Ammunition men: Remove the rounds from the ammunition bags and containers and pass the rounds to the assistant gunner as he directs, and then take positions to afford local security for the gunner and assistant gunner.

c. Safety checks during firing. The following safety checks are conducted during firing.

(1) The gunner:

(a) From time to time checks the clamp bolt and locking nut to see that they are tight.

(b) Checks frequently to see that the baseplate and bipod positions are safe for firing.

(2) The assistant gunner swabs the bore after every fire for effect or after every ten rounds.

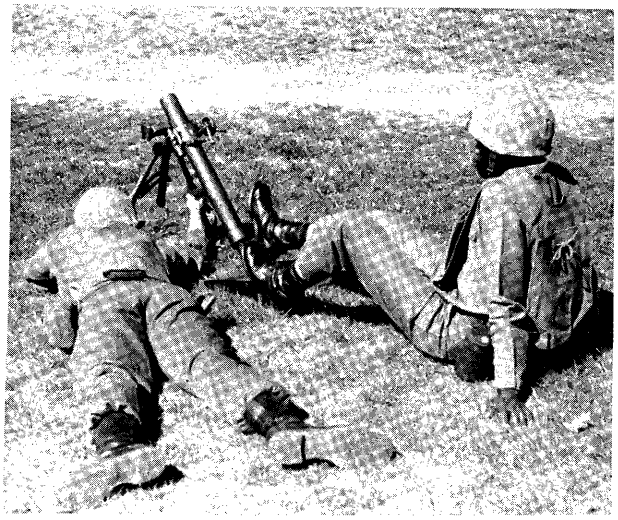
6-12. MISFIRES

a. General. A misfire occurs when a round is loaded into the barrel but fails to fire. Usually, the round strikes the firing pin but fails to function. In rare cases, the round may hang in the barrel without striking the firing pin. Frequently during mortar drill, when the section is simulating firing with dummy rounds, the section leader should announce MISFIRE and order the crew to remove the misfire.

b. Removal of round after misfire.

(1) The gunner kicks the barrel with his heel. This may dislodge a round that is stuck in the barrel; if the round is fired, the mortar is relaid and firing is continued. If the round is not fired, the assistant gunner then sets the firing selector on LEVER FIRE and trips the lever three times. If the mortar still fails to fire, the crew waits at least 1 minute before removing the round to avoid an accident caused by a possible delayed action of the propelling charge. During this period, the gunner tests the barrel for heat. If the barrel is cool at the end of 1 minute, the round is removed as described below. If the barrel is hot, pour water on the outside of the barrel until it is cool. If no water is available, all personnel stand clear of the mortar until it is cool.

(2) The gunner rises to a kneeling position and unlocks the mortar from the baseplate, braces the bipod by placing his left arm in front of the legs, and grasps the right leg at the hand grip. He places his right hand around the base cap. He is careful to keep his head and shoulders from in front of the muzzle. The assistant gunner from a kneeling position, places his right hand, palm up, under the barrel, and his left hand, palm down, on top of the barrel. He places his thumbs alongside the forefingers. He is careful to keep every part of each hand from in front of the muzzle. The gunner lifts the base of the barrel until the barrel is horizontal (fig 6-5). If the round fails to slide forward, the gunner keeps the barrel in a horizontal position and places it on the ground. Under no circumstances does he again lower the base of the mortar below a horizontal position until the round has been removed from the barrel. As soon as the barrel has reached the horizontal position, and not before, the assistant gunner places the thumb of each hand over the muzzle and stops the round as the point of the fuze reaches the muzzle. He then removes the round from the barrel, inspects it for the presence of the safety pin. If the safety pin is not present, he replaces the safety wire. He then determines the cause of misfire for this round. If the ignition cartridge is dented, the round is placed aside for destruction. If the primer is undented, the round may be refired after the mortar is remounted. The gunner raises the base of the barrel well above the muzzle and shakes the barrel to dislodge any remnants from the last round fired.



A. Kicking the barrel.

B. Unlocking the barrel.

C. The gunner raises the barrel.

Fig 6-5. Misfire clearing procedure.

(3) Then the gunner lowers the mortar and locks the spherical projection in the socket. He sets the selector on DROP FIRE and firing is resumed. If another misfire occurs, the gunner inspects the firing pin to see that it is clear and protruding beyond the surface of the firing pin bushing. If the firing pin is found to be faulty, the firing mechanism is disassembled and the defect corrected.

c. Causes of misfire. The propelling charge may not function because of:

(1) Defective primer or ignition cartridge.

(2) Defective or damaged firing pin or other parts of firing mechanism.

(3) Loose firing pin bushing.

(4) Firing pin fouled or obstructed by remnants from previous rounds.

(5) Fouled bore.

(6) Excess oil or water in bore.

(7) Cartridge not fully inserted in container.

(8) Misalined stabilizing fin.

(9) Foreign matter or excess paint on gas check band.

6-13. COMMON MISTAKES AND MALPRACTICES

Inaccuracies and waste in mortar fire often occur from repeated mistakes and malpractices. A mistake usually results from carelessness or lack of concentration and can be detected only by a positive, independent check or by very close supervision. A malpractice results from incomplete or incorrect training. The best preventive for mistakes and malpractices is the formation of proper habits during training, insisting on exactness and allowing no deviation from correct procedures. The following is a tabulation of some of the more common errors made at the mortar position:

a. Mistakes.

(1) Moving the components of the sight in the wrong direction from the numbered graduations on the micrometer scales.

(2) Firing the wrong type of round.

(3) Laying on the wrong aiming stakes, especially at night, or when there is little lateral interval between the mortars.

(4) Failing to center all bubbles.

b. Malpractices.

(1) Firing rounds from oily barrels.

(2) Failing to swab the bore after every 10 rounds or after every fire for effect.

(3) Attempting to fire too rapidly, that is, loading a round before the previous one has cleared the muzzle.

(4) Exceeding the maximum rates of fire, thus causing the barrel to become extremely hot. Rounds, cool from storage, may crack when placed in the hot barrel and may cause an explosion. If fired, the broken round endangers friendly troops.

(5) Not insuring that rounds and charges are protected from weather.

6-14. OUT OF ACTION

The normal method of taking the mortar out of action is to leave the baseplate attached to the mortar, so that the mortar can be carried as one unit and placed in action again quickly.

a. The gunner commands: OUT OF ACTION. He then removes the sight and dismounts the mortar.

b. All squad members secure their equipment and form as the gunner directs.

c. When the mortar is to be carried a considerable distance, the gunner may command: OUT OF ACTION, TWO-MAN LOAD. The gunner removes the baseplate so that it can be carried by a member of the squad that he designates.

Section IV. EMPLACEMENT OF MORTARS

6-15. MORTAR POSITIONS

a. Introduction. Mortar positions, as discussed here, are the actual locations of the individual mortars within the section position. Sometimes it may be necessary to fire the mortar from the surface of the ground. Whenever possible, the mortar is dug into the ground to provide protection for the mortar and crew from enemy countermortar fire. Camouflage of the mortar position and the surrounding area must be started as soon as possible and is a continuous process as long as the position is occupied.

b. Location of the mortar position. The mortar position should be placed in defilade from the enemy to limit observation and fire upon the position. Routes of supply and evacuation should be under cover if possible.

c. Construction of the position (fig 6-6). A mortar pit is dug into the ground. It should be about 2 feet deep and 8 feet in diameter, and its bottom should be flat and as level as possible to aid the mortar crew when firing in any direction. The earth in the center of the mortar pit should be loosened in very hard soil to help seat the baseplate. In soft soil, mud, sand or snow it will be necessary to place small tree limbs and sandbags under the baseplate to help cushion it. The mortar pit should be constructed so that rain will drain into a trough on one side, for ease in bailing. The pit cannot be dug any deeper into the ground than the sight unit. The sight unit has to be above the ground level in order to see the aiming posts. Additional protection can be accomplished by placing two or more layers of sandbags on the edge of the mortar pit. These sandbags can be quickly removed for large deflection changes. Grenade sumps should be provided on each side of the mortar. More elaborate positions may be constructed for long-term defensive positions and may include ammunition ready pits, deep protective holes for the mortar crew, and connecting trenches.

d. Camouflage. This must be started immediately upon occupation of the position. The mortar pit may be camouflaged with the standard camouflage net or with natural vegetation. If natural vegetation is used, it should be cut from outside the platoon position. Aiming posts may be painted with dull green paint to aid camouflage. Mortar crews must be careful when moving from the mortar position to the aiming posts because of the paths that may be worn. These paths will tend to look like spiderwebs from above and are a giveway to the mortar position.

e. Ammunition pit. The ammunition pit should be dug as soon as possible after the mortar is put into operation. This pit should be dug close enough to the mortar pit to pass ammunition between the two. A 3-foot dirt wall between these pits will afford good protection to the mortar crew in case of an explosion in the ammunition pit. The ammunition pit should be large enough to contain sufficient ammunition for the mission and should be covered with at least 30 inches of dirt to protect the ammunition from enemy fire. Always provide a sump for water drainage and store the ammunition on boards or logs at least 4 inches above the bottom of the pit. The ammunition pit must be camouflaged as soon as possible, and this camouflage must be maintained. Figure 6-6 is a good mortar position with an ammunition pit. Ammunition boxes and containers are a real camouflage problem. These boxes can be used in construction of positions or placed outside the mortar position and camouflaged.

f. Misfire pit. This pit will be constructed for any rounds that fail to fire. Rounds that are unsafe to fire are also placed in this pit. The misfire pit should be placed far enough from the mortar position to prevent injury to personnel in case these unsafe rounds explode. All rounds placed inside this pit should be tagged. The tag should identify the type of malfunction. In a tactical situation this pit must be protected from the enemy and camouflaged. In a nontactical situation the misfire pit must be plainly marked and security provided so that the misfired rounds are not handled, except by explosive ordnance personnel.

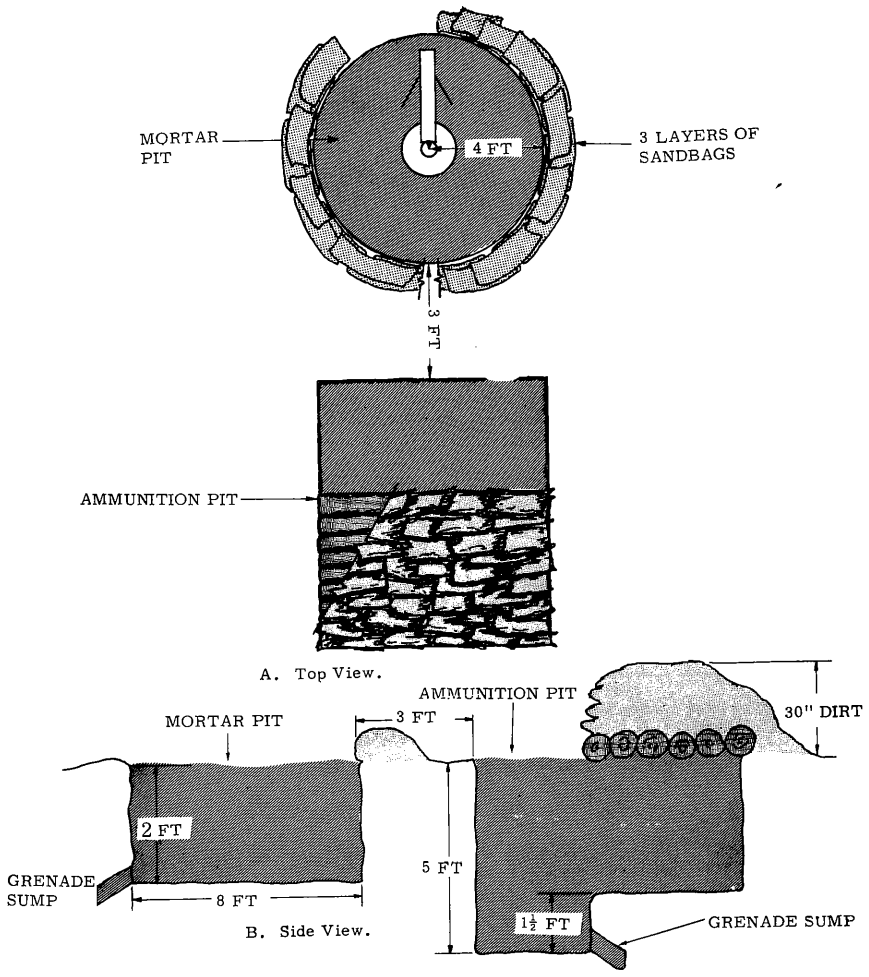


Fig 6-6. A typical mortar position.

Chapter 7

FORWARD OBSERVATION, FIRE CONTROL INSTRUMENTS, AND TACTICAL EMPLOYMENT

Section I. FORWARD OBSERVATION

7-1. INTRODUCTION

a. Mortars are always employed in a manner requiring visual observation. Since the 60-mm mortar is a part of the rifle company and does not rate a forward observer by T/O, the type of tactical employment of the 60-mm mortar section or squad will determine who will be the forward observer.

(1) General support. When the mortar section is in general support, the entire section supports all rifle platoons. The company commander designates persons from his command to be the forward observers. Normally one person at the company OP and each platoon CP/OP will be assigned the duties of forward observer.

(2) Direct support. When the section is in direct support of a platoon, the rifle platoon commander will designate the forward observer.

(3) Attachment. When the mortar squad(s) or section is attached to a rifle platoon, the platoon commander will designate the forward observer. If the mortar squad is attached to a rifle squad, the forward observer would be the squad leader or a fire team leader of the rifle squad.

b. Depending on the tactical situation, any member of the rifle company who has a means of communication with the mortars and can read a direction can adjust fire on any target he can see. (For a more detailed discussion on forward observation see MCI 08.4 and MCI 03.31.)

7-2. MISSION

The mission of the forward observer is to adjust mortar fire on hostile elements which interfere with the mission of the company.

7-3. DETERMINATION OF INITIAL DATA

a. The information needed when determining initial firing data is-

Initial direction of fire.
Initial range.

b. After the section leader has placed the mortars and pointed out the initial direction of fire, he will normally move to an advantage point where he can see the target area and the gun positions. Meanwhile, the squad leaders mount their mortars and lay them in the initial direction of fire. The section leader will determine the initial range and relay it to the squad leaders who put it on the mortars. This method of setting up the mortars is used when the section leader can go to a vantage point where he can see both the guns and the target. If he cannot go to such a point, he will remain with the guns and receive the initial data from the designated FO's and relay it to the squad leaders who operate the guns.

c. If the section leader is operating from the company OP, or if the mortars are attached to platoons or squads, any person designated as the forward observer may determine the initial direction of fire and initial range and relay this information to the squad leader who lays the mortar in the desired direction and places the range data on the mortar.

7-4. DIRECT ALINEMENT METHOD

This method is applicable only when the person determining the initial direction is on or near the mortar-target (MT) line. If the section is being used, the section leader determines the initial direction. If a squad is attached out, the squad leader determines the initial direction. There are two ways of determining initial direction in the direct alinement method, one for when the mortar position is not fixed and one for when the mortar position is fixed.

a. Mortar position not fixed. The section leader indicates the approximate mortar position, he moves forward to a point where he can best see the target, placing himself on the MT line, and drives the M10 aiming post on this line. He turns the alidade until it forms a crosspiece on the aiming post and tightens the wingnut. He sights along the straightedge of the alidade on the target (fig 7-1). Without disturbing the position of the alidade, he moves around the aiming post, and sights back along the same edge to the mortar position and directs that the baseplate stake be driven on this line of sight. The squad leader will drive the baseplate stake into the ground. The mortar is mounted and the left edge of the baseplate is alined with the aiming post stake. When the aiming post is at such a distance or in such a position that it cannot be seen clearly from the mortar position, a second stake is driven into the ground to be used as an aiming stake on the MT line. It is placed about 25 meters from the baseplate stake.

b. Mortar position fixed. This method is used when the baseplate has been seated by previous firing or when the terrain limits the mortar position to a definite spot. The person determining the initial direction may establish a new direction of fire by the direct alinement method. He repeats the procedure used for the mortar not fixed to include sighting back to the mortar position. If the stake is off the MT line, he moves it in the required direction and repeats the procedure until the aiming stake is on the MT line.

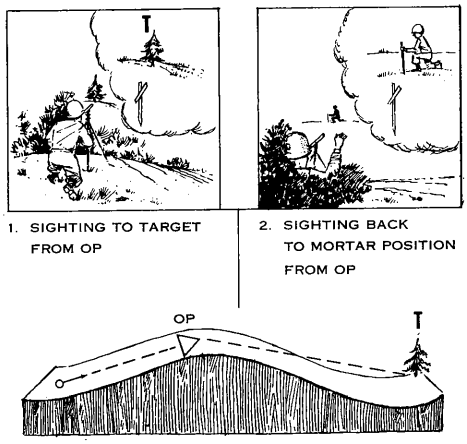


Fig 7-1. Direct alinement method.

7-5. DIRECT LAYING METHOD

There may be a situation where no defilade is available or where speed in destroying a target is more essential than cover. In such a situation, the squad leader points out the target and directs that the mortar be mounted immediately without aiming posts (fig 7-2). Usually, such a position is temporary and is evacuated as soon as the target is destroyed. When the target is indistinct and the squad leader has indicated only its direction, he lays the mortar himself as soon as it is mounted. The mortar is laid and fired in the same manner as described for indirect laying except that one clearly defined edge or point of the target is used as the aiming point. When it is apparent that bursts may obscure the target from observation, any suitable aiming point in the target area may be used. Then the squad leader measures the deviation between the aiming point and the target and includes it in the initial fire command. This method is also used with the hand-held mortar.

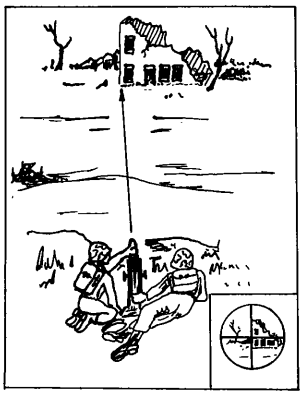


Fig 7-2. Direct laying method.

7-6. COMPASS DIRECTION METHOD

The compass direction method is the method most frequently used to establish initial direction for the mortars. This method is used when the observer cannot see the mortar position from his position on or near the mortar-target line. He places himself approximately on the MT line. To help establish this line, he selects a landmark at or near the mortar position before moving to the OP (fig 7-3). He reads the magnetic direction in mils to the target and sends this direction back to the mortar position by radio. If no radio is available, the observer will take a member of the section with him to the OP as a messenger, and send the messenger back to the mortar position with the direction. The squad leader, after receiving the direction, places a baseplate stake where the baseplate is to be positioned. He then places a compass on the baseplate stake and rotates the compass until he can sight through the compass on the specified direction. He directs that a direction stake be placed on the line established by the compass direction. The mortar is mounted on the spot marked by the baseplate stake and laid in the direction established by the direction stake.

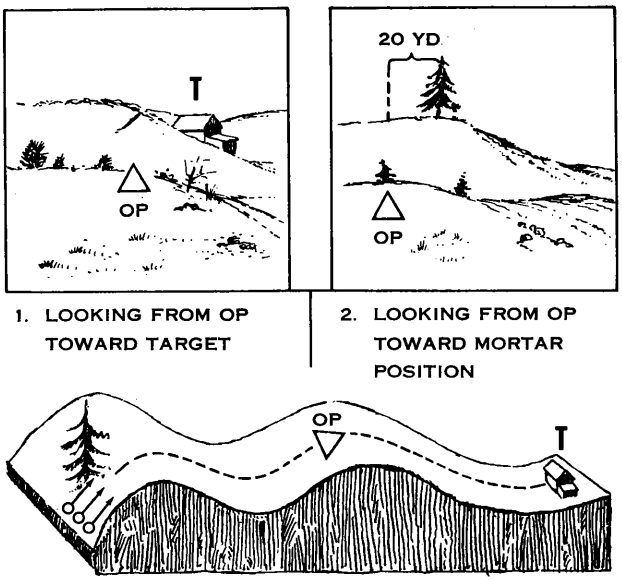


Fig 7-3. Direction method.

7-7. PARALLEL LINE METHOD

The observer may use this method when he is off the mortar-target line (fig 7-4). It is simple, rapid, and accurate enough for field use. The observer estimates the shortest distance from his position to the MT line. He selects an object on the ground which is on the same side of the MT line and at the same distance from this line as himself. With a compass, he reads the magnetic direction from his position to the selected object. This is the direction of the MT line. For example, in figure 7-4 the observer at point O estimates the shortest distance to the line MT as 125 meters. He then selects some object to his front which he estimates as 125 meters from the MT line and on the same side of that line as he is. Such a point in this case would be on the line OX. The direction of the line OX, therefore, is the same as the direction of the MT line.

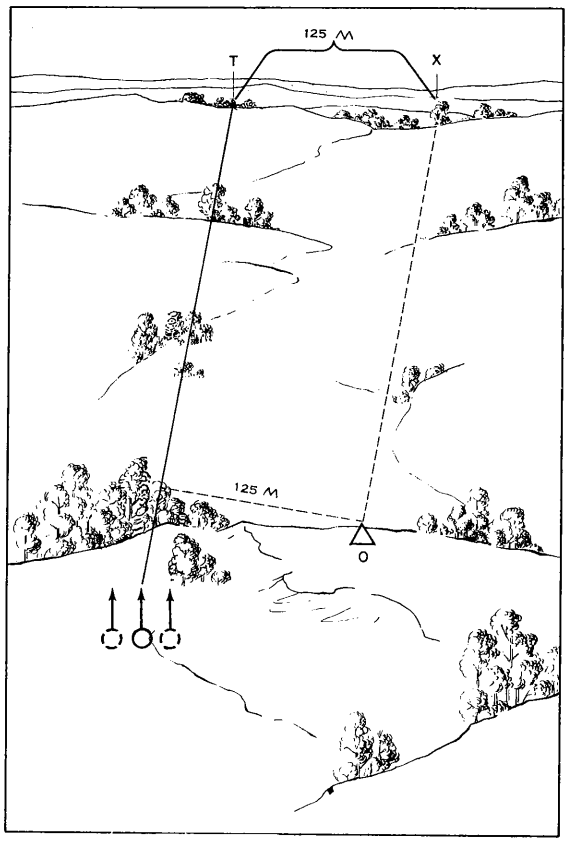


Fig 7-4. Parallel line method.

7-8. MAP METHOD

a. The mounting direction may be obtained from a map, photomap, or aerial photograph. First, locate both the mortar position and the target position on the map or photo. Next, draw a line between the mortar and the target. This is the mortar-target line.

b. When a protractor is used, extend the mortar-target line until it intersects a vertical grid line. Lay the protractor on the map or photomap with its index at this intersection and the straightedge along the vertical grid line. Read the direction from the mortar to the target. Then convert this map (grid) direction into a magnetic direction and send it to the mortar position as the mounting direction (fig 7-5).

c. When a compass is used, orient the map or photo with the compass. Place the line of sight of the compass along the mortar-target line drawn on the map or photo. Then read the direction indicated by the compass index. This is the magnetic direction from the mortar to the target that is sent to the mortar position as the mounting direction (fig 7-6).

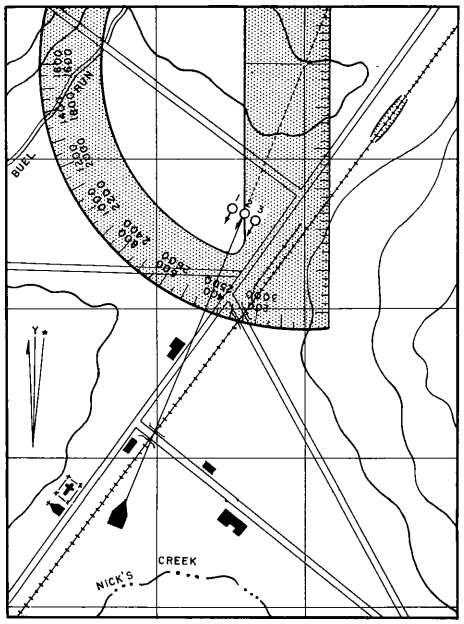


Fig 7-5. Map and protractor method.

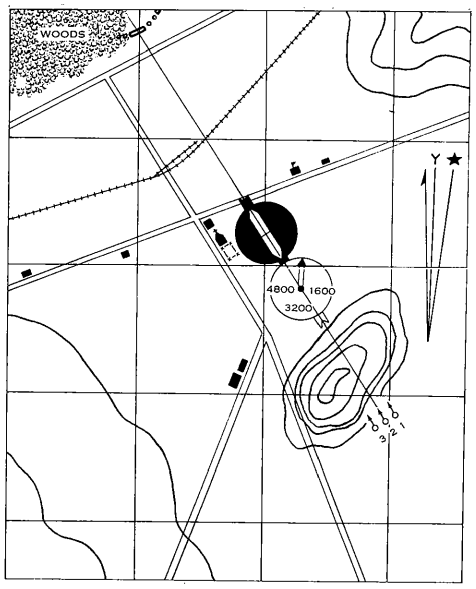


Fig 7-6. Map and compass method.

d. When no north-south line has been placed on an aerial photograph, you may determine such a line by first locating your position accurately on the photo. Then pick out some prominent terrain feature which can be located on both the ground and the photo. Draw a line on the photo from your location to the terrain feature. By use of a compass, read the magnetic direction to the terrain feature. With the index of the protractor on the point which indicates your location on the photo, rotate the protractor around its index until the direction of the line of your position-terrain feature is indicated by its proper reading on the protractor scale. Without moving the protractor, draw a line along the straightedge of the protractor. This line is the magnetic north-south line of the aerial photo.

7-9. RANGE DETERMINATION

a. Introduction.

The observer usually estimates the range by eye. However, he may determine the range from a map or aerial photograph. No matter how he first determines the range from the mortar to the target, it is usually necessary to determine the exact range by adjustment before firing for effect.

b. Estimating by eye.

The purpose of training in range estimation is to teach the Marine how to estimate range by eye with the minimum amount of error. In combat, ranges are usually estimated by eye; therefore, all Marines should be trained in this method. Stress is placed on estimating ranges between 200 and 1,500 meters.

(1) Estimation by eye is a method of measuring the range by applying to it a unit of measure 100 meters long. This method is the same as that used in measuring the length of a board with a ruler. The only difference is that the unit of measure is applied mentally. Thorough familiarity with the 100-meter unit and its appearance on different types of terrain and at different distances enables the estimator to apply it with a fair degree of accuracy.

(2) Application of the unit of measure beyond 500 meters is difficult. To estimate ranges over 500 meters, select a point halfway to the target, apply the 100-meter unit up to this halfway point, and double the result.

(3) The average of a number of estimates by different men is generally more accurate than a single estimate. However, in combat the Marine relies on his own estimate.

(4) When using the appearance of objects as a basis of range estimation, you should make allowances for the following effects:

(a) Objects seem nearer when:

1. They are in bright light.

2. Their color contrasts sharply with the background.

3. The observer is looking over water, snow, or a uniform surface such as a wheat field or rice paddy.

4. The observer is looking down from a height.

5. They are in the clear atmosphere at high altitudes.

6. The observer is looking over a depression, most of which is hidden.

7. The observer is looking down a straight road or railroad track.

(b) Objects seem more distant when:

1. The observer is looking over a depression, most of which is visible.

2. They are in poor light or fog.

3. Only a small part of the object can be seen.

4. The observer is looking from low ground toward higher ground.

7-10. LATERAL DISTANCE DETERMINATION

The observer must be able to tell quickly and with reasonable accuracy the shift, right or left, in meters from a burst, registration point, or reference point to a target. There are two ways to measure this distance. First, he can use an angle-measuring instrument, such as field glasses, and actually measure the deviation in mils. Second, he can use his hand and fingers (held at arm's length) to measure the angle (fig 7-7). At all times, when using this second method, the hand and fingers must be placed at the same distance from the eye. Before going into the field, each man practices measuring angles with and determines the various measurements of his own hand. After getting a measurement in mils by either of the two methods, the observer uses the mil formula to obtain the width in meters between the object or bursts and the target. (See appendix I for mil relation.)

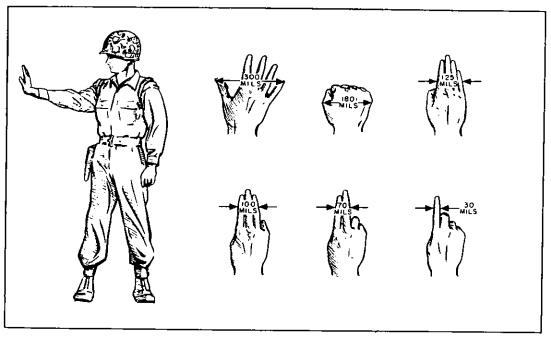


Fig 7-7. Measuring angles with the hand.

7-11. SPOTTING MORTAR BURSTS

a. General. Spotting is the determination by the observer of the location of a burst or group of bursts with respect to the target. When the burst appears, the observer immediately spots the location, except when necessary to take advantage of drifting smoke. He bases his spotting on what he sees while the burst is before his eyes, not on what he remembers. When spottings are made on drifting dust or smoke, the observer considers the wind direction.

b. Range spotting (fig 7-8). A burst which is beyond the target from the observer is spotted OVER for range; one which is between the target and the observer is spotted SHORT for range. A round which hits the target is spotted TARGET, and one which is at the correct range, but slightly off the OT line, is spotted RANGE CORRECT. Range is spotted DOUBTFUL when no positive spotting is obtained. When a round is spotted doubtful for range, the observer tries to get a positive spotting by moving the next burst to the OT line; this is done by giving a deflection correction with no change in range. A POSITIVE SPOTTING is made from any round which can be definitely located for both range and deviation.

c. Deviation spotting (fig 7-8). Rounds are spotted for deviation as RIGHT, LEFT, or LINE. The observer spots all errors in deflection by measuring, in mils, the deviation of each burst from the OT line. The mil scale in the binoculars may be used for this purpose. A burst to the right (left) of the OT line is spotted (so many mils) RIGHT (LEFT).

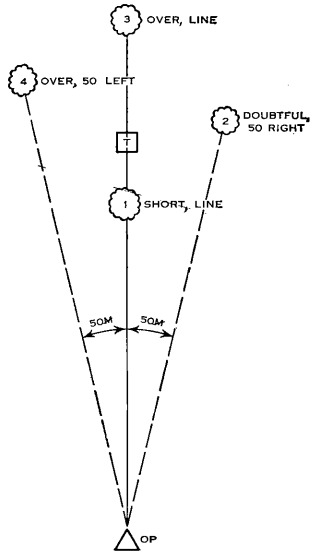


Fig 7-8. Spotting.

7-12. OBSERVER WITHIN 100 METERS OF THE MORTAR POSITION

The observer's best location for rapid fire adjustment is at the mortar position. Here his deviation spotting and the deflection correction to be placed on the sight are numerically equal. The tactical employment of the mortar, however, usually makes it necessary for the observer to be separated from the mortar. Nevertheless, the mortar should be placed whenever possible within 100 meters of the OP. If the observer takes a position in front, in rear, or to one side of the mortar position, but within 100 meters of it (fig 7-9), the errors in deflection can be measured from the target to the burst by means of the mil scale in the binoculars and applied directly to the mortar. This can be done because the MT line is so close to the OT line that the two lines are the same for all practical purposes. For example, if the observer, from a position within 100 meters of the mortar location, spots the burst to be left of the target and reads 30 mils on the mil scale of his binoculars, he orders a correction of RIGHT THREE ZERO.

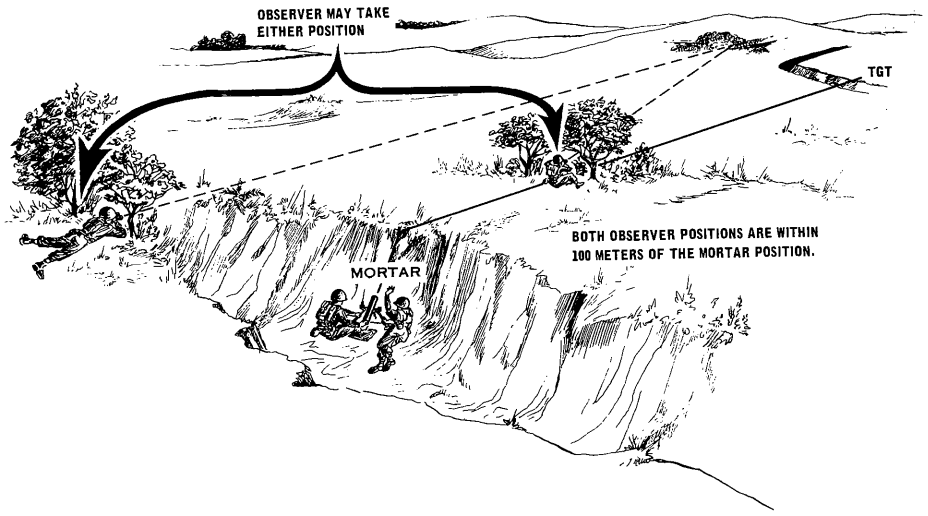


Fig 7-9. Observer within 100 meters of the mortar position.

7-13. OBSERVER MORE THAN 100 METERS FROM THE MORTAR POSITION

a. Observer within 100 meters of the MT line. When the mortar cannot be moved to within 100 meters of the OP, it should at least be placed so that the OP is within 100 meters of the MT line. Then the MT line and the OT line again are the same for all practical purposes. However, the deviation which the observer reads will not be the same as the deflection to be set on the mortar sight. If the observer is in front of the mortar, the deviation spotting will be greater than the deflection to be set on the mortar. For example, if he is halfway between the mortar and the target, his deviation spotting will be twice the correction to be made on the sight; if the mortar is halfway between the observer and the target, his deviation spotting will be half the correction to be made on the sight. Since the other distances give other ratios, it is necessary to apply a correction factor to the number of mils spotted before ordering a deflection change. This factor is a fraction, with the distance observer-target over the distance mortar-target; that is —

$$\text{Correction factor} = \frac{\text{Distance observer-target}}{\text{Distance mortar-target}} \text{ or } \frac{OT}{MT}$$

For example, if the OT distance is 600 meters, the MT distance 800 meters, and the deviation of burst from the target as read by the observer is 40 mils (fig 7-10), the correction ordered is:

$$\frac{600}{800} \text{ (or } 3/4) \text{ x } 40 \text{ mils} = 30 \text{ mils}$$

In applying this factor, simplicity and speed should be sought. Therefore, distances used should be to the nearest even 100 meters.

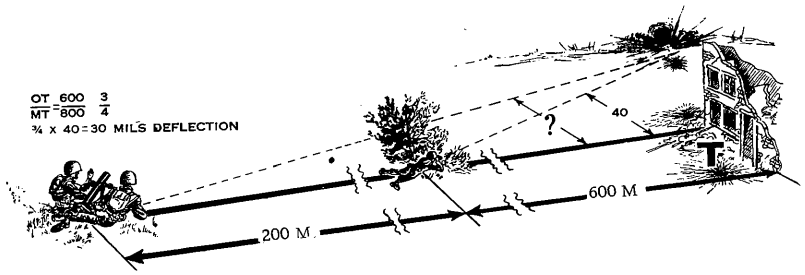


Fig 7-10. Observer more than 100 meters from mortar position on the MT line.

b. Observer more than 100 meters from the MT line. When the mortar cannot be placed so that the observer is within 100 meters of the MT line, the MT line and the OT line no longer can be considered the same. As a result, the deviation read by the observer will not even approximate the deflection correction to be set on the sight. For example, in figure 7-11, the observer at A (the mortar position) reads the actual deflection which should be set on the sight. If he moves to B, he sees the burst as if it were directly in line with the target. If he moves to C, he reads a deviation that is greater than the deflection correction to be set on the sight. Since the distances an observer moves off the MT line vary according to terrain and tactical situations, two general methods of computing corrections when the observer is more than 100 meters from the MT line are described below.

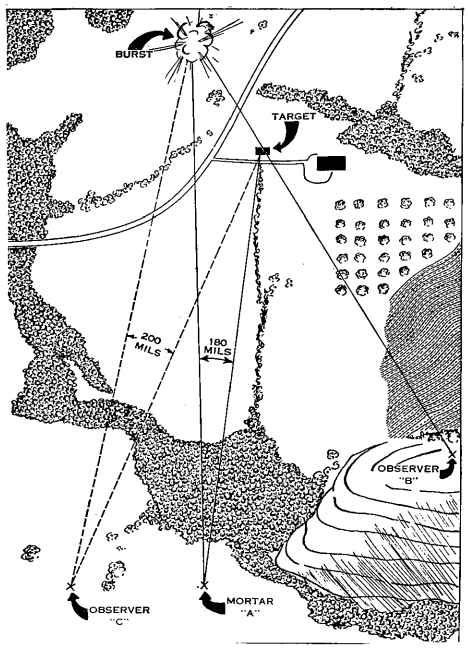


Fig 7-11. Spotting when observer is more than 100 meters from MT line.

(1) The target-grid method of determining subsequent corrections can be used. In this method, the leader acts as both observer and computer. As an observer, he spots and corrects each burst. Then, as a computer, he graphically keeps the bursts on the OT line by using the M10 plotting board to determine the subsequent deflection and range corrections. He plots the desired location of each burst on the plotting board (with the board oriented on the OT direction), determines the firing data, and issues the fire command. By measuring with his binoculars, he converts the deviation in mils between the burst and the target into a deflection shift in meters before plotting the desired location of the next burst.

(2) The observer may control mortar fire when he is more than 100 meters off the MT line by visualizing the MT line on the ground and then spotting and making corrections for that line. His spottings are made in meters and deflection corrections are computed in mils, using the MT range.

Example: In figure 7-12, it will be assumed that the observer has transmitted by sound-powered telephone, arm-and-hand signals, or radio, an initial fire command to the gunner at the mortar position as follows:

NUMBER ONE

HE

ONE ROUND

ZERO, BASE STAKE

EIGHT HUNDRED

The first round is fired, and the observer spots it as short and 50 meters left of the MT line. In order to convert the deflection in meters to mils, he uses the mil formula or the deflection conversion table and finds that the number of mils is 64. To correct the errors in deflection and range, his subsequent correction is:

RIGHT SIX FIVE

NINE HUNDRED

The second round is fired and the observer spots it as over, and 25 meters right of, the MT line. Again he changes his deviation spotting from meters into mils at the MT range of 900 meters and finds it to be 28 mils. His next correction is:

LEFT THREE ZERO

EIGHT FIVE ZERO

Subsequent errors in deviation and range are corrected by the procedure described above until the observer is satisfied with fire for adjustment.

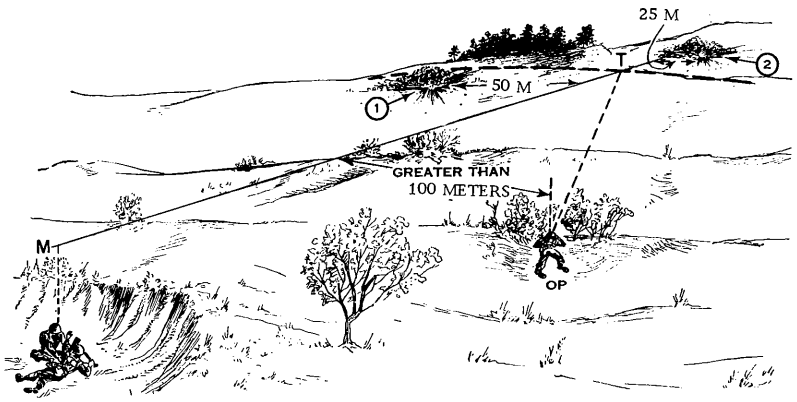


Fig 7-12. Spottings when distance from OP to MT line is greater than 100 meters.

7-14. LENSATIC COMPASS

a. Types. The lensatic compass is standard for use with the 60-mm mortar. Several models of this compass are in service, all of which are similar. Other types include the prismatic compass and the watch compass. The watch compass is unsuitable for use as a fire control instrument.

b. Description. One type of lensatic compass is shown in figure 7-13. The carrying case is made of plastic. The hinged eyepiece contains a magnifying lens and is slotted on the end for sighting. The compass dial, pivoted in the center, is doubly graduated, the outer scale reading in mils, the inner scale in degrees. The slotted end contains a wire which is marked at each end by a luminous dot. The crystal is movable and has a luminous line for use at night.

c. Use.

(1) The chief use of the lensatic compass in mortar units is to measure magnetic directions. It can be used as a marching compass.

(2) To take readings, place the compass on a level surface, when possible, or on a flat-topped aiming stake. By using the holding ring for support, it can be read while held in the hand. Hold the compass with the dial as nearly level as possible to permit the needle to swing freely.

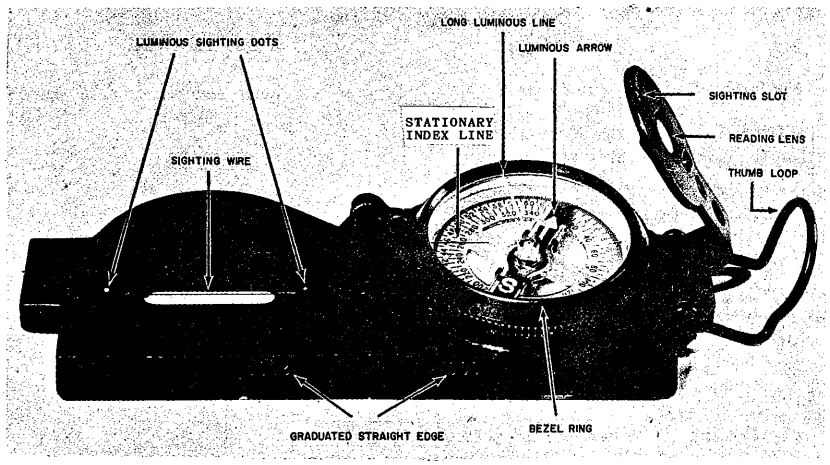


Fig 7-13. Lensatic compass.

d. Operation.

(1) To measure a direction, raise the eyepiece and cover; sight through the slot in the eyepiece and the sighting wire on the cover (fig 7-14). Rotate the compass until the line of sight bisects the object. Without altering the position of the compass, look through the eyepiece lens, and read the direction on the scale.

Fig 7-14. Proper method of sighting with a compass.

(2) To determine back direction, read the direction to the object. If the direction is less than 3, 200 mils, add 3, 200 mils; if greater, subtract 3, 200 mils.

(3) To determine the horizontal angle between two points, read the direction to each point and subtract the smaller reading from the larger. The difference is the angle. In the event magnetic north lies between the two points, the resulting difference must be subtracted from 6, 400. The difference then will be the angle desired.

(4) To lay off a direction at night, place the compass under some type of shield (raincoat or shelter-half) and use a flashlight or other light to illuminate it. Then turn the compass until the desired reading on the dial is opposite the stationary index. Move the luminous line on the crystal to coincide with the north arrow on the compass dial. Then, without using a light, move to the position from which the direction is to be determined. Hold the compass level and rotate it until the north arrow on the compass dial coincides with the luminous line on the crystal. The stationary index and the luminous sight dots on the hinged cover then point in the desired direction.

e. Care and preservation. Although the instrument is strongly constructed, protect the needle pivot bearing and its jeweled support against shocks. To lock the needle, close the compass cover. Always close the cover when the compass is not in use.

7-15. BINOCULAR M17A1

a. Description. The M17A1 (7x50)is the standard binocular used for observation and approximate measurement of small angles (fig 7-15). It consists of two compact prismatic telescopes pivoted about a hinge. This hinge permits the telescopes to be adjusted to the width between the observer's eyes. The left telescope contains the reticle. This instrument is comparatively light so that it can be easily carried for ready use.

Fig 7-15. M17A1 binocular.

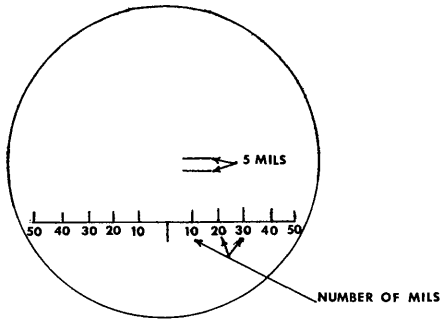


Fig 7-16. M17A1 binocular reticle.

(1) The reticle (fig 7-16) has a horizontal mil scale graduated and numbered at 10-mil intervals from 50 mils right to 50 mils left of the center of the field of vision. Above the horizontal line are two series of reference marks. These marks are spaced 5 mils apart for convenience in observing fire. The vertical scale has no application to mortar firing.

(2) The neck strap, secured to the strap loops of the instrument, prevents accidental dropping and keeps the instrument within easy reach. A russet leather carrying case with a carrying loop and shoulder strap protects the instrument when it is not in use. The instrument is carried in the case with the eyepiece up. When replacing the binocular in the case, the diopter scale setting need not be disturbed but the hinge may need adjusting.

b. Operation.

(1) Setting interpupillary distances. To set the binocular so that the eyepieces are the same distance apart as the observer's eyes, first look through the glass at some fairly distant object; then open or close the glasses at the hinge until the field of vision ceases to be separate or overlapping circles and appears to be one sharply defined circle.

(2) Focusing. Look through the eyepieces, both eyes open, at a fairly distant object. Place a hand over the front of one telescope and screw the focusing nut of the other in or out until the object is sharply defined. Repeat for the other eye. Then check the diopter scale reading on each eyepiece. This is helpful in making a similar setting on the eyepieces of other field glasses. Do not touch any optical surface.

(3) Observing. Hold the binocular in both hands, and press the eyepieces lightly to the eyes to avoid transmission of body tremors to the instrument. The hands may be cupped around the eyepiece and touching the face in order to eliminate light coming in between the eyepieces and the eyes. When possible, use a rest for the binocular or elbows.

(4) Use of the reticle. The mil scales are seen superimposed on the observed objects. The horizontal and vertical angles may be read from the mil scales.

c. Care and preservation. The binocular is rugged in construction, but do not subject it to rough handling. Do not disassemble or lubricate it, but refer all repairs involving disassembly or painting to ordnance. The binocular is resistant to moisture. However, during wet weather carefully wipe the binocular dry before returning it to the carrying case. Wipe the optical surfaces carefully with lens tissue paper.

7-16. MIL SCALE ALIDADE

a. Use of mil scale alidade on M10 aiming post. When the M10 aiming post is not used as an aiming stake, the observer may use the mil scale alidade to obtain the initial direction of fire. He may also use the mil scale on the alidade to measure horizontal angles. To use the mil scale, which has a 200-mil field, the observer pivots the alidade at right angles to the post, tightens the wingnut, places the spike of the post against his cheek, and sights across the alidade.

b. Improvised mil scale alidade.

(1) An improvised mil scale alidade (fig 7-17) may be used to measure horizontal angles. A scale placed on the alidade with approximately 3/16-inch graduations measures 10 mils between markings when held 18 inches from the eye. A total of 400 mils may be measured with this scale.

Fig 7-17. Improvised mil scale alidade.

(2) To fasten a cord to the alidade, place a hook at each end or drill two small holes through it. Place these holes 2 inches apart, with the 200-mil graduation halfway between the holes. Then insert the cord through the hooks or holes and tie it at a length so that when the cord is looped around the neck and drawn taut, the scale is 18 inches from the eye. When measuring a horizontal angle, place the zero of the scale on the burst or target, whichever is farther to the left. Then read the distance between them on the scale.

Section III. TACTICAL EMPLOYMENT

7-17. TYPES OF EMPLOYMENT

Basic decisions on the employment of the 60-mm mortar section are made by the rifle company commander. He directs the employment of the mortar section to support the company's scheme of maneuver. This is normally accomplished through recommendations made by the weapons platoon commander. The mortars may be employed in general support, direct support, or attachment.

a. General support. When the mortar section is in general support, it supports all rifle platoons as directed by the company commander. By keeping the section in general support the company commander gains flexibility, better coordination of fires, more effective mass firepower, and ability to achieve timely fire effect. Direct tactical control of the section remains with the weapons platoon commander. Fires are controlled from the company observation post when observation of the entire company zone of action is possible from that position. If not, additional OPs are established.

b. Direct support. When the mortar section is employed in direct support, the weapons platoon commander is responsible for the control of the section's actions in support of a specific rifle platoon. He is also responsible for the selection and occupation of firing positions, for reconnaissance and displacement to provide maximum fire support at all times, and for the supply of the section. The section leader establishes direct liaison with the supported rifle platoon commander and conducts fire missions as requested by him. Separate mortar squads normally are not employed in direct support of rifle platoons.

c. Attachment. When the mortar squad(s) or section is attached to a rifle platoon, control of the squad(s) or section passes from the company commander to the rifle platoon commander. Attachment is justified when the mortar section cannot give adequate support to a rifle platoon by operating in general or direct support. This method, however, is undesirable except when the supported rifle platoon is conducting operations such as the advance party in the approach march, a patrol moving out of mortar range, a withdrawal, or in a platoon strongpoint defense. When a mortar squad is attached to a rifle platoon, the rifle platoon commander assumes the tactical command, supply, and administrative functions normally exercised by the weapons platoon commander. The chief disadvantages of this method of employment are:

(1) Complete loss of control by the company commander.

(2) Difficult resupply of ammunition.

(3) A relatively powerful weapon is employed in piecemeal fashion when it is attached out by squads.

7-18. OFFENSIVE EMPLOYMENT

a. Mission. The mission of the 60-mm mortar section in offensive combat is to give close continuous fire support to the attacking elements of the infantry company.

b. Targets. The 60-mm mortar is suitable for employment against the same general type of targets in the attack as is the 81-mm mortar. It does not fire the high-explosive heavy shell and should not be employed against fortified positions. Point targets within 900 meters of the guns can be engaged effectively. The massed fires of all mortars in the section can effectively cover an area target 150 meters wide and to 50 meters deep with each mortar firing 4 rounds. Because of the difficulty in ammunition supply, the 60-mm mortar is fired at known targets only, and is not employed against suspected targets as is the 81-mm mortar.

c. Firing positions. In the attack the most suitable firing positions are in any defilade area close to the line of departure. The section firing position should possess the same characteristics as the 81-mm mortar position. In other combat operations such as the movement to contact or combat patrols where the direct-lay technique of fire is likely to be employed, the firing positions may be in full view of the target.

d. Displacement.

(1) General. When the mortar section is employed in general or direct support, displacement in the attack is normally ordered by the company commander through the weapons platoon commander. However, if displacement is necessary and the company commander is not available, the weapons platoon commander orders displacement on his own initiative. In the attached role,the mortar squad(s) is displaced on order of the rifle platoon commander.

(2) Time of displacement. Displacement is ordered when friendly troops mask the fire of the mortar(s) by their close approach to the objective, when observation is masked, when displacement will make better observation available, or when the assault units outdistance the effective range of the mortars.

(3) Method of displacement.

(a) Section. Depending on the circumstances, one squad may displace while the other two remain in firing position, or two squads may displace while one squad remains in firing position. Exceptionally, the entire section will displace at one time. The squad which has displaced goes into firing position and provides fire support while the remaining squads displace. At least one mortar should be kept in firing position at all times to ensure continuous support for the company. During periods in the progress of an attack when there are no fire missions for the mortar section, the weapons platoon commander acting through the section leader may take advantage of the lull and order the displacement of one or two squads so that one or more mortars will have completed the movement to,and be prepared to fire from,new positions, and thus more effectively assist the attack when supporting fires are again required.

(b) Squad. When the mortar squad is attached to a rifle platoon in the attack, the rifle platoon commander would order displacement: (1) to keep mortar fires in fire support range of advancing infantry, or (2) during consolidation. Mortar fires may be used in a pursuit by fire role or support against enemy counterattack from the initial fire support position in the vicinity of the line of departure. Displacement may be ordered when mortar fires are masked by assaulting infantry, provided 81-mm mortar or artillery fires are available to support consolidation of the objective.

7-19. DEFENSIVE EMPLOYMENT

a. Accomplishment of missions. In company defense positions the mortar section is normally employed in the general support role. The mission in defense and the methods of accomplishing it follow generally the same principles as for the 81-mm mortar. The final protective fire of one 60-mm mortar, however, is 50 meters square, and the target plotted as a 50-meter circle. The final protective fire may be located within 50 meters of the FEBA. Thus, the 60-mm mortar can cover small gaps in the machinegun final protective line close to the FEBA. The company commander coordinates the fires of the 60-mm with 81-mm mortars. Targets over 500 meters forward of the FEBA are normally covered by the 81-mm and/or 4.2 mortars.

b. Sectors of fire. The sector of fire for the section OP is the entire company security area. The weapons platoon commander indicates in his defense order whether or not the section leader will fire at targets on his own initiative.

c. Firing positions. Because of its low silhouette, the 60-mm mortar can take advantage of folds in the ground, stream beds, or shell holes for firing positions. In the defense, firing positions should be located between 150 and 500 meters in rear of the FEBA. When possible, the three mortars of a section are emplaced as a section, regardless of the number of OPs. This simplifies control and ammunition resupply. Squad firing positions are separated by at least 35 meters. It is desirable to locate positions approximately in the center of the company forward defense area in order to provide short lines of communication to all parts of the FEBA. The requirements of a good position are as follows:

(1) Defilade

(2) Proximity to observation post necessary because of limited communication equipment and case of adjustment procedures.

(3) Concealment.

(4) Covered route of supply.

d. Rate and duration of fires. In the absence of any instructions the normal rate of fire is 30 rounds per minute for the first two minutes and 18 rounds per minute thereafter for the duration of final protective fires. The section leader will normally specify the number of rounds to be expended on each target. The company commander may set the number of rounds to be fired for final protective fires and targets in his defense order.

APPENDIX I

THE MIL RELATION

I-1. DEFINITIONS

For computing firing data, the unit of length or distance is the meter, while the unit of angular measure is the mil (m/). One mil is equal to 1/6400 of a circle just as one degree is equal to 1/360 of a circle. For practicle use, a mil may be defined as the angle which subtends a width of approximately one unit at a distance of 1000 units. In other words, a mil is an angle that is approximately 1 meter wide at a distance of 1,000 meters, or 3 meters wide at a distance of 3,000 meters (fig I-1). For angles of 600 mils or less, the mil relation is accurate enough for use in computing firing data.

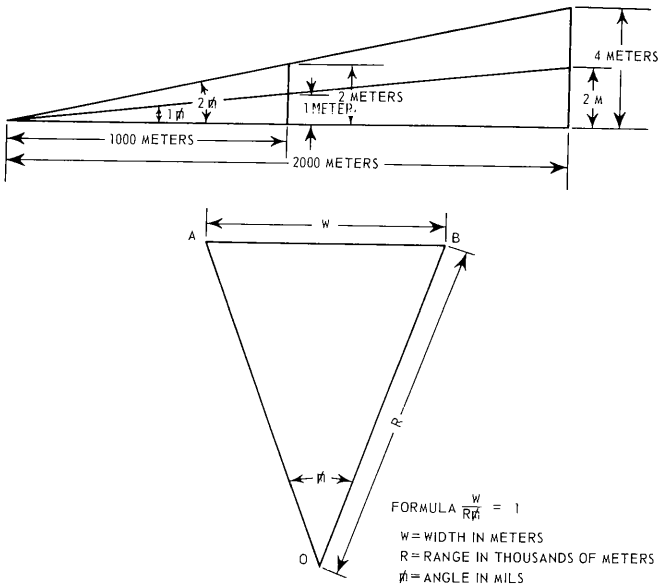


Fig I-1. Mil relation.

I-2. USE OF THE MIL FORMULA

a. The mil relation may be expressed in the mil formula, W/Rm/=1. This formula is easy to remember as the W over Rm/:

W represents width in meters.
m/ represents angular measurement in mils.
R represents the range or distance in thousands of meters.

b. Example (fig I-2). An observer desires to know the distance between two objects (A and B). He estimates the range to be 1,200 meters, and with his binocular he reads the angle AOB to be 40 mils.

R=1200/1000=1.2 (thousands of meters); m/=40 Substituting in the formula
W/Rm/=1 (or W=Rm/) W=1.2x40=48 meters

Any one of the three elements of the formula may be determined when the other two are known (fig I-2).

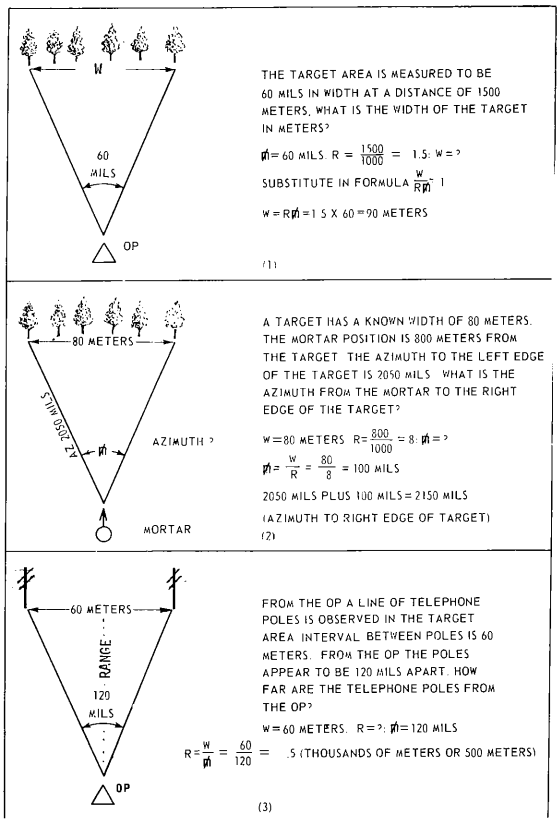

W
60
MILS
OP
THE TARGET AREA IS MEASURED TO BE 60 MILS IN WIDTH AT A DISTANCE OF 1500 METERS. WHAT IS THE WIDTH OF THE TARGET IN METERS?
m = 60 MILS. R = 1500/1000 = 1.5; W = ?
SUBSTITUTE IN FORMULA W/Rm = 1
W = Rm = 1.5 X 60 = 90 METERS
(1)
80 METERS
AZIMUTH 2050 MILS
m
AZIMUTH ?
MORTAR
A TARGET HAS A KNOWN WIDTH OF 80 METERS. THE MORTAR POSITION IS 800 METERS FROM THE TARGET. THE AZIMUTH TO THE LEFT EDGE OF THE TARGET IS 2050 MILS. WHAT IS THE AZIMUTH FROM THE MORTAR TO THE RIGHT EDGE OF THE TARGET?
W = 80 METERS. R = 800/1000 = 8; m = ?
m = W/R = 80/8 = 100 MILS
2050 MILS PLUS 100 MILS = 2150 MILS
(AZIMUTH TO RIGHT EDGE OF TARGET)
(2)
60 METERS
RANGE
120
MILS
OP
FROM THE OP A LINE OF TELEPHONE POLES IS OBSERVED IN THE TARGET AREA. INTERVAL BETWEEN POLES IS 60 METERS. FROM THE OP THE POLES APPEAR TO BE 120 MILS APART. HOW FAR ARE THE TELEPHONE POLES FROM THE OP?
W = 60 METERS. R = ?; m = 120 MILS
R = W/m = 60/120 = .5 (THOUSANDS OF METERS OR 500 METERS)
(3)

Fig I-2. Problems involving the mil formula.

I-3. USE OF DEFLECTION CONVERSION TABLE

It is often necessary in preparing and conducting fire to convert, at various distances, meters of deflection to mils or mils to meters. The deflection conversion table shown in figure I-3 may be used for this purpose.

a. Example 1. To determine the equivalent in mils for 100 meters at a distance of 1,200 meters, read horizontally on the line marked 1200 to the column headed 100. The number of mils is 85.

b. Example 2. To determine the equivalent in meters for 95 mils at a distance of 800 meters read horizontally on the line marked 800 until 95 mils is found. Then look up that column to determine the number of meters, which is 75.

c. Example 3. To determine the equivalent in meters for 65 mils at a distance of 700 meters, it is necessary to interpolate. Reading in the 700-meter line, note that there is no 65 mil number. It falls about halfway between the numbers 58 and 73. At a distance of 700 meters 58 mils equals 40 meters and 73 mils equals 50 meters. As 65 is approximately halfway between 58 and 73, at 700 meters 65 mils equal 45 meters.

(Deflection in mils)

Range (meters)	Deflection in meters													
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	2.0	20	41	61	81	102	152	201	250	297	343	388	550	687	800
600	1.7	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1.5	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1.3	13	25	38	51	64	95	127	158	189	219	250	365	472	569
900	1.1	11	22	34	45	57	85	113	141	168	195	223	328	426	517
1,000	1.0	10	20	31	41	51	76	102	127	152	176	201	297	388	474
1,100	.93	9	18	28	37	46	69	92	115	138	161	183	271	355	435
1,200	.85	8	17	25	34	42	64	85	106	127	148	168	249	328	402
1,300	.79	8	16	24	33	39	59	78	98	117	136	155	231	304	374
1,400	.73	7	15	22	29	36	55	73	91	109	127	145	215	283	349
1,500	.68	7	14	20	27	34	51	68	85	102	118	135	204	265	328
1,600	.63	6	13	19	25	32	48	64	80	95	111	127	189	250	309
1,700	.60	6	12	18	24	30	45	60	75	90	104	119	178	235	291
1,800	.57	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1,900	.54	5	11	16	21	27	40	54	67	80	94	107	160	211	262
2,000	.51	5	10	15	20	25	38	51	64	76	89	102	152	201	250

Fig I-3. Deflection conversion table.

APPENDIX II

FIRING TABLES

II-1. INTRODUCTION

To convert ranges in meters into elevations in degrees and number of propellant increments (referred to as charges), use the firing tables that are packed with each bundle of ammunition. These tables include a deflection conversion table.

II-2. USE OF THE FIRING TABLES

a. Always select the lowest charge for the initial range that permits a subsequent increase or decrease of 200 meters in range without changing the charge. For example, using the HE shell for an initial range of 800 meters, use a charge 2, elevation 65.3° as shown in figure II-1. At a range of 1450 meters we would have to use a charge 4 because a charge 3 does not allow an increase of at least 200 meters without changing the charge.

b. It is undesirable during adjustment of fire to change to a different charge zone. Fire adjustment is less accurate where there is a shift between charge zones during adjustment.

c. In firing on targets involving searching fires, select the elevation in degrees that will permit the use of the same charge throughout. For example, using the HE shell for zone 1000 to 1100 meters, use charge 3 with the corresponding elevations.

d. In firing on targets involving creeping fire, select the elevation in degrees that will permit the use of the lowest charge. For example, using the HE shell for an initial range of 200 meters, 64.2° charge 0.

FT 60-L-3

CARTRIDGE, HE, M49A2E2
FUZE, PD, M525

RANGE (M)	ELEV (DEG)	CHG	ELEV (DEG)	CHG
50	84.4	0		
75	81.5	0		
100	78.5	0		
125	75.4	0	84.4	1
150	72.0	0	83.2	1
175	68.4	0	82.1	1
200	64.2	0	80.9	1
225	59.1	0	79.7	1
250	51.1	0	78.5	1
275			77.2	1
300			75.9	1
325			74.6	1
350			73.3	1
375			71.9	1
400	79.0	2	70.5	1
425	78.2	2	69.0	1
450	77.5	2	67.4	1
475	76.7	2	65.7	1
500	75.9	2	63.9	1
525	75.2	2	62.0	1
550	74.4	2	59.9	1
575	73.5	2	57.4	1
600	72.7	2	54.5	1
625	71.9	2	50.4	1
650	71.0	2		
675	70.1	2		
700	69.2	2	75.4	3
725	68.3	2	74.8	3
750	67.3	2	74.2	3
775	66.3	2	73.6	3
800	65.3	2	73.0	3

RANGE (M)	ELEV (DEG)	CHG	ELEV (DEG)	CHG
800	65.3	2	73.0	3
825	64.2	2	72.4	3
850	63.1	2	71.8	3
875	61.9	2	71.1	3
900	60.6	2	70.5	3
925	59.3	2	69.8	3
950	57.8	2	69.1	3
975	56.2	2	68.5	3
1000	54.4	2	67.8	3
1025	52.2	2	67.0	3
1050	49.2	2	66.3	3
1075			65.5	3
1100			64.7	3
1125			63.9	3
1150			63.1	3
1175			62.2	3
1200	68.8	4	61.3	3
1225	68.2	4	60.4	3
1250	67.6	4	59.4	3
1275	67.0	4	58.3	3
1300	66.4	4	57.2	3
1350	65.2	4	54.6	3
1400	63.9	4	51.3	3
1450	62.6	4	45.5	3
1500	61.1	4		
1550	59.5	4		
1600	57.8	4		
1650	55.9	4		
1700	53.7	4		
1750	51.0	4		
1800	47.0	4		

Fig II-1. Firing table for HE M49A4 round.

FT 60-L-3

CARTRIDGE, WP, M302E1
FUZE, PD, M527

RANGE (M)	ELEV (DEG)	CHG	ELEV (DEG)	CHG
50	82.6	0		
75	78.7	0		
100	74.6	0	84.1	1
125	70.0	0	82.6	1
150	64.8	0	81.0	1
175	58.0	0	79.4	1
200			77.8	1
225			76.2	1
250			74.5	1
275			72.7	1
300	79.5	2	70.9	1
325	78.5	2	68.9	1
350	77.6	2	66.8	1
375	76.6	2	64.6	1
400	75.6	2	62.1	1
425	74.6	2	59.2	1
450	73.6	2	55.8	1
475	72.5	2	50.7	1
500	71.5	2		
525	70.4	2		
550	69.2	2		
575	68.0	2		
600	66.8	2	74.2	3
625	65.5	2	73.5	3
650	64.1	2	72.7	3
675	62.7	2	71.9	3
700	61.1	2	71.1	3
725	59.4	2	70.3	3
750	57.5	2	69.5	3
775	55.4	2	68.7	3
800	52.7	2	67.8	3

RANGE (M)	ELEV (DEG)	CHG	ELEV (DEG)	CHG
800	52.7	2	67.8	3
825	48.8	2	66.9	3
850			65.9	3
875			65.0	3
900			64.0	3
925			62.9	3
950			61.8	3
975			60.7	3
1000	67.6	4	59.4	3
1025	66.8	4	58.1	3
1050	66.1	4	56.6	3
1075	65.3	4	55.0	3
1100	64.5	4	53.1	3
1125	63.7	4	50.7	3
1150	62.8	4	47.1	3
1175	61.9	4		
1200	61.0	4		
1225	60.0	4		
1250	59.0	4		
1275	57.9	4		
1300	56.7	4		
1325	55.5	4		
1350	54.0	4		
1375	52.4	4		
1400	50.4	4		
1425	47.7	4		

Fig II-2. Firing table for WP M302A1 round

☆ U. S. GOVERNMENT PRINTING OFFICE : 1981—341-318/T-238